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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 4, NUMBER 2
JANUARY 15, 1971

W71-00551--W71-01100

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency A directory of the Centers appears on inside back cover.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1954, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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03 WATER SUPPLY AUGMENTATION AND CONSERVATION
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04 WATER QUANTITY MANAGEMENT AND CONTROL
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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

STATISTICAL MODELS FOR SURFACE RENEWAL IN HEAT AND MASS TRANSFER, PARTS III. AND IV.,
Argonne National Lab., Ill.
L. B. Koppel, R. D. Patel, and J. T. Holmes.
AIChE Journal, 16 (1970), No 3, p 456-471; 5 fig, 2 tab, 15 ref.

Descriptors: *Interfaces, Boundary processes, *Heat transfer, *Mass transfer, Boundaries, *Statistical models, Frequency analysis, Systems analysis, Surfaces, Diffusion.
Identifiers: Fluid mechanics.

A method was developed for estimating the age density of transporting elements at a transport surface by using the spectral density of the total element counts. Only total counts, and not individual element histories, need be observed. The method was compared with autocorrelation methods used in an earlier work. Residence times were measured for several sizes of particles at a particular wall surface of a stirred fluidized bed and at various gas velocities using both spectral density and autocorrelation methods. A dimensionless plot brought all data points near a single curve, valid only for this surface in this bed. Checks of these residence times against values obtained by direct observation of individual particles confirmed the methods. Heat transfer coefficients were measured for glass particle at the same wall surface of a fluidized bed for which glass particles residence times were measured in a previous study. The data compared well with theoretical predictions of the dependence of heat transfer coefficients on particle residence times. Heat transfer coefficients for metal particle systems, for which direct measurements of residence times were not available, were predicted with fair accuracy by estimating residence times from a dimensionless correlation proposed in a previous study. The ability of the particle surface renewal models to accurately predict heat transfer coefficients is strong evidence of their physical validity. (Novotny-Vanderbilt)
W71-00648

THERMODYNAMIC PROPERTIES OF LIQUID H2O AND D2O AND THEIR MIXTURES,
National Aeronautics and Space Administration, Cambridge, Mass. Electronics Research Center.
Mark Salomon.
For sale by NTIS as NASA TND-5223, $3.00 in paper copy, $0.95 in microfiche. National Aeronautics and Space Administration Technical Note D-5223, May 1969. 12 p, 5 tab, 27 ref.

Descriptors: *Water properties, *Deuterium, *Thermodynamics, *Enthalpy, Thermal properties, Data collections, Physicochemical properties, Chemical properties, Chemical reactions.
Identifiers: Equilibrium constants.

The liquid and gas phase equilibria H2O .. D2O — 2HDO have been reinvestigated. By combining spectroscopic and vapor pressure data, fairly good agreement is found between the experimental and calculated enthalpy for the liquid phase reaction. The value of the equilibrium constant for the liquid phase reaction is very close to the geometric mean value of 4.0. (Knapp-USGS)
W71-00887

1B. Aqueous Solutions and Suspensions

ADSORPTION OF ORGANIC COMPOUNDS ONTO SOLIDS FROM AQUEOUS SOLUTIONS,
Virginia Polytechnic Inst., Blacksburg.
James P. Wightman, Leslie R. Dole, Clarence A. King, and Russell K. Lengel.
Available from NTIS as PB-195 309, $3.00 in paper copy, $0.95 in microfiche. Virginia Water Resources Research Center Bulletin, Completion Report, October 1970. 12 p. OWRR Project A-026-VA (1).

Descriptors: *Adsorption, *Surface tension, *Surfaces, Aqueous solutions, Phenol, Polarity, Wettability.
Identifiers: *Gas chromatography, *Surface area, *Critical surface tension, Infrared spectra, Polymers.

The research involved a study of factors effecting adsorption of phenol from aqueous solution on six solids of varying polarity including polymers of known surface area. The amount of phenol adsorbed over a wide range of phenol concentration was determined by a gas chromatographic technique. The critical surface tensions of the polymers were determined by contact angle measurements. Reflection infrared spectra were obtained on the powdered solids. Anomalously large quantities of phenol were taken up by microcrystalline Nylon presumably by an adsorption process.
W71-00633

INFLUENCE OF SURFACE TURBULENCE AND SURFACTANTS ON GAS TRANSPORT THROUGH LIQUID INTERFACES,
California Univ., Berkeley.
Thomas G. Springer, and Robert L. Pigford.
Industrial Engineering Chemical Fundamentals, Vol 9, (1970), No 3, p 458-465. 8 fig, 5 tab, 17 ref.

Descriptors: *Boundary processes, *Air-water interfaces, Mass transfer, Heat transfer, Evaporation, Convection, *Turbulence, Statistical models, Mathematical models, Diffusion, *Surfactants.

A new experimental technique is used to measure the effects of surface turbulence and surfactants on mass transfer rates at gas-liquid interfaces. At high turbulence rates the statistical nature of interfaces, with and without surfactants present, may be described by a Danckwerts-type distribution function of surface ages. Measurements of surface film mass transfer resistances show that soluble surfactants offer no measurable resistance, while insoluble films show definite resistance to passage of gas molecules. The nature of surface films and their stability in the presence of interfacial turbulence are discussed. The results were drawn from data taken at high turbulence rates, where the scale of turbulence was much greater than the depth of penetration of the dissolving gas. In all turbulent runs, no visual change in the surface turbulence could be seen. (Novotny-Vanderbilt)
W71-00646

ION-ION AND ION-MOLECULE INTERACTIONS IN AQUEOUS SALT SOLUTIONS,
Connecticut Univ., Storrs. Inst. of Water Resources.
W. L. Masterton.
Available from NTIS as PB-195 312, $3.00 in paper copy, $0.95 in microfiche. Technical Completion Report, June 30, 1970. 5 p. OWRR Project A-013-CONN (7).

Descriptors: Osmosis, *Ions, *Electrolytes.
Identifiers: *Salt effect, *Osmotic coefficient, Complex ion electrolyte, Apparent molal value, Activity coefficient, Partial molal value, Solubility nonelectrolytes, Ion pair, Conductivity.

Studies have been carried out on the thermodynamic properties and structure of aqueous solutions of complex ion electrolytes derived from cobalt (III). The work involves the determination of osmotic and activity coefficients, conductivities, salt effects and partial molal volumes. The data indicates that complex ion electrolytes in aqueous solution are more strongly ion paired than simple salts of the same valence type. Aromatic hydrocarbons are salted in by complex ion electrolytes.
W71-00705

THERMODYNAMIC PROPERTIES OF LIQUID H2O AND D2O AND THEIR MIXTURES,
National Aeronautics and Space Administration, Cambridge, Mass. Electronics Research Center.
For primary bibliographic entry see Field 01A.
W71-00887

PROTON MAGNETIC RESONANCE STUDY OF COUNTERION AND SOLVENT EFFECTS ON 14N QUADRUPOLE RELAXATION IN TETRAALKYLAM-MONIUM IONS,
Missouri Univ., Kansas City. Dept. of Chemistry.
David W. Larsen.
Journal of Physical Chemistry, Vol 74, No 18, p 3380-3384, September 1970. 2 fig, 1 tab, 26 ref. OWRR Project A-022-MO (1).

Descriptors: *Electrolytes, Aqueous solutions, *Ions, *Soluation, Water properties, Water structure, Equilibrium, Ionization, Diffusion, Viscosity.
Identifiers: *Ion pairing, Detergents.

Nuclear magnetic resonance lineshapes for ocmethyl protons in (CH3)4N (..) and (CH3)3NCH2CH3 (..) salts were studied. The dependence of the lineshapes on salt concentration, added electrolyte concentrations, solvent, and temperature was studied. The observed effects are caused by the N (14) quadrupole relaxation rate, which is governed by the nature of fluctuating field gradients at the N (14) nucleus. Electric field gradients and correlation times are discussed in terms of structure of the cations, solvent interactions, and ion pairing. The small temperature dependence of the lineshapes suggests that the correlation decay mechanism is rotation of the cation. The results are interpreted in terms of contact ion pairs in dimethyl-sulfoxide solution and solvent separated ion pairs in aqueous solution. The present results for R4N (..)X (-) ion pairs are in agreement with previous results for R4N (..)MXn (3-) ion pairs from studies of n.m.r. pseudocontact effects.
W71-00943

02. WATER CYCLE

2A. General

PREDICTING AND MAPPING THE AVERAGE HYDROLOGIC RESPONSE FOR THE EASTERN UNITED STATES,
Georgia Univ., Athens.
James F. Woodruff, and John D. Hewlett.
Water Resources Research, Vol 6, No 5, p 1312-1326, October 1970. 15 p, 4 fig, 3 tab, 10 ref. OWRR Project A-d18-GA.

Descriptors: *Rainfall-runoff relationships, *Storm runoff, *Mapping, *Small watersheds, Synoptic analysis, Drainage patterns (Geologic), Maps, Runoff forecasting, Streamflow forecasting, Discharge (Water), Data collections, Hydrologic data, Hydrogeology, Flood forecasting, Water storage, Stream gages, Gaging stations.

An attempt was made to predict the average annual hydrologic response (ratio of annual direct runoff to annual precipitation) of ungaged watersheds in the East by regression against 15 planimetric, hypsometric, and land use factors available on 90 selected test basins (2 to 100 square miles) from New York to Alabama. The regression coefficients were nonsignificant indicating that the average percentage of a basins's annual precipitation that will become quick flow cannot be predicted from available basin morphometry and implying that response is controlled chiefly by porous mantle factors not measurable on normal data sources. A hydrologic response map of the eastern United States based on an expanded set of 201 basins up to 200 square miles revealed specific regions of high flood producing potential clearly related to geologic provinces. It is suggested that hydrologic response is a meaningful parameter that may be best derived by measuring precipitation and

streamflow by cheap, short-term methods traditionally rejected as uneconomical. (Knapp-USGS)
W71-00551

RECESSION AND THE BASEFLOW PROBLEM,
Imperial Coll. of Science and Technology, London (England).
For primary bibliographic entry see Field 02E.
W71-00577

THEORETICAL ESTIMATES VERSUS FOREST WATER YIELD,
West Virginia Univ., Morgantown. Div. of Forestry.
For primary bibliographic entry see Field 03B.
W71-00587

PARTIAL AREA CONTRIBUTIONS TO STORM RUNOFF IN A SMALL NEW ENGLAND WATERSHED,
Agricultural Research Service, Danville, Vt.
Thomas Dunne, and Richard D. Black.
Water Resources Research, Vol 6, No 5, p 1296-1311, October 1970. 16 p, 11 fig, 1 tab, 16 ref.

Descriptors: *Storm runoff, *Rainfall-runoff relationships, *Small watershed, *Overland flow, Soil water movement, Hydrogeology, Soil water, Permeability, Precipitation excess, Depth-area-duration analysis, Percolation, Rainfall disposition.
Identifiers: Sleepers River Experimental Watershed (Vt).

During an experimental study of runoff producing mechanisms in a small drainage basin, the major portion of storm runoff was produced as overland flow on a small proportion of the watershed. Where the water table intersected the ground surface before and during a storm, water ran quickly to the stream at velocities 100 to 500 times those of the subsurface system. Direct precipitation onto the saturated area was another major contributor of storm flow. Storage of water was small and travel times out of them were short. These areas contributing quick runoff could expand or contract seasonally or during a storm. Their position and expansion can be related to geology, topography, soils, and rainfall characteristics. In the study basin, water that remained below the ground surface on its way to the main stream channel was a relatively minor contributor to the storm hydrograph. Measurements of water table elevation and runoff from experimental plots in another small watershed with different geologic conditions confirmed the results. Runoff records from a large number of small basins of the Sleepers River experimental watershed indicate the general applicability of these findings. (Knapp-USGS)
W71-00588

MODELING THE EFFECT OF LAND USE MODIFICATIONS ON RUNOFF,
Agricultural Research Service, Brookings, S. Dak.; and Water Resources Board, Reading (England).
For primary bibliographic entry see Field 04C.
W71-00589

NONLINEAR TIME VARYING MODEL OF RAINFALL-RUNOFF RELATION,
Pittsburgh Univ., Pa.
Chao-Lin Chiu, and J. T. Huang.
Water Resources Research, Vol 6, No 5, p 1277-1286, October 1970. 10 p, 16 fig, 7 ref. OWRR Project C-1146.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Hydrograph analysis, Time series analysis, Parametric hydrology, Systems analysis.
Identifiers: Non-linear models.

The developed nonlinear time varying model of a hydrologic system that relates the rainfall and the runoff is represented by a pair of nonlinear ordinary differential equations with time varying coefficients. The model does not require the linearity and time invariance assumptions necessary in conventional unit hydrograph methods. The nonlinear and time varying characteristics of the system are incorporated into the model through four basic system parameters. The model is empirical and its field application procedure is feasible and simple, since its derivation is based on the physical system response observed. In an illustrative field application the model and procedure proved effective, relative to other linear time invariant models, in predicting the rain-runoff relation, especially when the rainfall excess occurred during a very short time interval. (Knapp-USGS)
W71-00590

ON THE WATER BALANCES OF SOME INDIAN STATIONS,
Meteorological Office, Poona (India).
For primary bibliographic entry see Field 02D.
W71-00595

WATER BALANCE OF LAKE CHALA AND ITS RELATION TO GROUNDWATER FROM TRITIUM AND STABLE ISOTOPE DATA,
International Atomic Energy Agency, Vienna (Austria).
For primary bibliographic entry see Field 02H.
W71-00601

AN UNCONVENTIONAL APPROACH TO FLOOD FREQUENCY ANALYSIS,
Technion - Israel Inst. of Tech., Haifa.
Joseph S. Dalinsky.
Bulletin International Association of Scientific Hydrology, Vol 15, No 3, p 55-59, September 1970. 5 p, 5 ref.

Descriptors: *Rainfall-runoff relationships, *Statistical methods, *Flood forecasting, *Frequency analysis, Rain gages, Data collections, Hydrologic data, Meteorological data, Data processing, Digital computers, Mathematical models.
Identifiers: Flood frequency.

It is suggested that flood-frequency analysis be based on regional rainfall analysis, a combination of physical and statistical analyses making use of all data. The statistical analysis should refer mainly to rainfall data. Rainfall data are more numerous, especially as data from a number of stations of the same region can be used simultaneously or alternately, as long as their rainfall regimes and rainfall quality are identical. Rainfall data are more reliable and easier to measure. Rainfall is stochastic. Generally, the known frequency distribution of rainfall intensities of different durations is log-normal, or nearly so. An analysis of rainfall-runoff relations should be based not only on all reliable data, but also on an understanding of the physical nature of hydrologic processes. (Knapp-USGS)
W71-00861

ON THE COMPUTER EVALUATION OF THIESSEN WEIGHTS,
Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center.
M. H. Diskin.
Journal of Hydrology, Vol 11, No 1, p 69-78, July 1970. 10 p, 2 fig, 2 tab, 2 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff forecasting, *Computer programs, *Small watersheds, *Routing, Hydrograph analysis, Networks, Data processing, Rain gages, Digital computers.
Identifiers: Thiessen weights, Thiessen method.

To shorten the time required for rainfall-runoff calculations in watersheds, an improved method is presented for evaluating the Thiessen weights or coefficients by a digital computer. The new method is based on covering the area of the watershed with uniform, equally spaced test points on a rectangular grid and assigning each such point to the nearest rain-gaging station. The number of points assigned to any station relative to the total number of points that fall inside the boundaries of the watershed gives the weight of the station. The new procedure is faster and gives more accurate results than a previous program based on random test points. The complete listing of the new computer program in Fortran IV may be obtained from the author or from the Southwest Watershed Research Center, Tucson, Arizona. (Knapp-USGS)
W71-00864

RESPONSE UNITS FOR EVALUATING THE HYDROLOGIC PERFORMANCE OF RANGELAND WATERSHEDS,
Agricultural Research Service, Boise, Idaho. Northwest Watershed Research Center.
For primary bibliographic entry see Field 02G.
W71-00866

CLOUD SEEDING, AREA OF EFFECT NUMERICAL MODEL,
Aerometric Research, Inc., Goleta, Calif.
For primary bibliographic entry see Field 02B.
W71-00912

RANGE RESOURCES AND WATERSHED MANAGEMENT--A NEED FOR RESEARCH,
Utah State Univ., Logan. Dept. of Range Science.
For primary bibliographic entry see Field 04D.
W71-00959

TRITIUM IN SURFACE WATER HYDROLOGY-EXPERIMENTAL DETERMINATION OF THE RUNOFF COEFFICIENT (FRENCH),
Bureau of Geological and Mining Research, Orleans (France).
Edith Crouzet, Pierre Hubert, Philippe Olive, Erik Siwertz, and Adrien Marce.
Journal of Hydrology, Vol 11, No 3, p 217-229, September 1970. 13 p, 7 fig, 5 tab, 6 ref.

Descriptors: *Surface-groundwater relationships, *Rainfall-runoff relationships, *Floods, *Tracking techniques, *Tritium, Hydrogeology, Subsurface runoff, Hydrograph analysis, Hydrologic cycle, Tracers, Base flow, Discharge (Water), Infiltration, Overland flow, Rainfall disposition.
Identifiers: France.

To establish the relative proportions of surface-runoff and groundwater discharge it is possible to measure the amounts of tritium in rainwater, groundwater, and the outflow from a particular drainage basin. From such data, the part of the total discharge due to direct runoff can be established. At Pont des Blaves, France, the greater part of the flood waters passing on 11/7/1968 appeared to consist of displaced groundwater. To a lesser extent this proved also to be the case with the discharge at Charmoisy (2/8/1968), situated within the same drainage basin. On the other hand, the discharge at Verthier (23 to 29/12/1968) was largely due to precipitation. Earlier radiometric methods have used Sr-90 and Cs-137 as indicators. Tritium, however, is to be preferred because it is not adsorbed by the soil. The proposed method should give insight into water balance and especially into the hydrological cycle in drainage basins. (Knapp-USGS)
W71-01060

THE PROGRESS OF HYDROLOGY: VOL 1--NEW DEVELOPMENTS IN HYDROLOGY.
Illinois Univ., Urbana.

Ven Te Chow, Chairman. Proceedings 1st International Seminar for Hydrology Professors, Illinois University, Urbana, July 13-25, 1969, published by Univ of Illinois, 1969. 509 p.

Descriptors: *International Hydrological Decade, *Conferences, *Research and development, *Water resources development, Forecasting, Hydrology, Hydraulics, Planning, Projects, Research facilities, Exploration, Economics, Instrumentation, Laboratories, Model studies, Technology, Computers.
Identifiers: *Water resources research.

In recent years there has been a tremendous amount of activity in the field of hydrology. The International Hydrological Decade which began in 1965 is just one example of such activities. As it is generally recognized that the science of hydrology is basic to all plans of water resources development, new national and international attention and interest in water resources have further stimulated the progress of hydrology. These activities have exposed two significant facts: (1) new technologies applicable to hydrology are being rapidly developed, and (2) urgent need for modern hydrologic education is well recognized in government as well as in scientific communities. As a first step to meet the need for a progressive hydrologic education, an International Seminar for Hydrology Professors was held from July 13 to 25, 1969, in Urbana, Illinois, U.S.A. The theme of the seminar was limited to new developments in the field of hydrology, to hydrologic teaching and research at colleges and universities, and to the relation of hydrology with governments, society and professions. A total of 62 papers were presented and preprinted for distribution at the seminar. Of these papers, 20 were on new developments in hydrology, 19 on specialized subjects in hydrology, 10 on hydrologic education, and 13 on various country reports. (See also W71-01068 thru W71-01087) (Knapp-USGS)
W71-01067

SOME OF ESSA'S CURRENT EFFORTS IN SATELLITE DATA APPLICATIONS FOR HYDROLOGY,
National Environmental Satellite Center, Washington, D.C.
For primary bibliographic entry see Field 07B.
W71-01068

SPACE TECHNOLOGY IN HYDROLOGIC APPLICATIONS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07B.
W71-01069

REMOTE SENSING IN SPACE TECHNOLOGY IN HYDROLOGY,
Connecticut Univ., Storrs. Dept. of Civil Engineering.
For primary bibliographic entry see Field 07B.
W71-01070

SCIENTIFIC HYDROLOGY IN THE UNITED STATES,
Illinois Univ., Urbana. Dept. of Civil Engineering.
William C. Ackermann.
In: The Progress of Hydrology, Vol 1 - New Developments in Hydrology, Proceedings 1st International Seminar for Hydrology Professors, Illinois University, Urbana, July 13-25, 1969, p 50-60, published by Univ of Illinois, 1969. 11 p, 1 fig.

Descriptors: International Hydrological Decade, Conferences, *Research and development, *Water resources development, *Systems analysis, Social aspects, Forecasting, Hydrology, Hydraulics, Water pollution control, Water quality, Remote sensing, Statistics, Planning, Projects, Research facilities, Exploration, Economics, Instrumentation, Laboratories, Model studies, Technology, Computers.
Identifiers: *Water resources research.

Over the past 50 years hydrology has evolved from a largely descriptive science of the natural hydrologic cycle. Hydrology is in the process now of adapting technologies which have come in part from outside of hydrology for improved sensing, statistical evaluation, electronic calculation, and systems analyses. One of societies' problems is with quality of the environment, and a part of the response to this should be by far greater concern with natural and degraded water quality as well as the traditional concern with quantity. (See also W71-01067) (Knapp-USGS)
W71-01071

SCIENTIFIC HYDROLOGY IN THE WORLD,
Utah State Univ., Logan. Coll. of Engineering.
Dean F. Peterson.
In: The Progress of Hydrology, Vol 1 - New Developments in Hydrology, Proceedings 1st International Seminar for Hydrology Professors, Illinois University, Urbana, July 13-25, 1969, p 26-49, published by Univ of Illinois, 1969. 24 p, 2 tab, 9 ref.

Descriptors: International Hydrological Decade, Conferences, *Research and development, *Water resources development, Forecasting, Hydrology, Hydraulics, Planning, Projects, Research facilities, Exploration, Economics, Instrumentation, Laboratories, Model studies, Technology, Computers.
Identifiers: *Water resources research.

The present state of the science of hydrology is summarized for an IHD seminar held in 1969. A major part of international scientific effort in hydrology falls within the program of the International Hydrological Decade which, first proposed in 1961 was implemented under a Coordinating Council of UNESCO January 1, 1965. Efforts of the IHD fall into the general categories of (1) basic data; (2) inventories and water balances; (3) research projects; (4) exchange of information, symposia and publication, and (5) education and training in hydrology. The developing countries tend to place highest priority on development of their resources in order to meet the extremely pressing needs for economic growth; whereas, the developed countries tend to give relatively higher priority to environmental problems as such, and to the more sophisticated scientific problems. (See also W71-01067) (Knapp-USGS)
W71-01072

DETERMINISTIC NONLINEAR HYDROLOGIC MODELS,
Geological Survey, Washington, D.C.
J. Amorocho.
In: The Progress of Hydrology, Vol 1 - New Developments in Hydrology, Proceedings 1st International Seminar for Hydrology Professors, Illinois University, Urbana, July 13-25, 1969, p 420-472, published by Univ of Illinois, 1969. 53 p, 12 fig, 37 ref.

Descriptors: *International Hydrological Decade, *Conferences, *Research and development, *Model studies, *Mathematical models, Parametric hydrology, Forecasting, Hydrology, Hydraulics, Simulation analysis, Input-Output analysis, Operations research, Planning, Research facilities, Systems analysis, Model studies, Technology, Computers.
Identifiers: *Water resources research.

The deterministic approach has been very fruitful in the development of a number of techniques for the representation of various elements of the hydrologic cycle, and has led to useful results in practical application. Completely general models applicable to all circumstances are not available, but such generality may neither be necessary nor entirely desirable. While the types of models discussed operate in a deterministic manner on the input data supplied, the results of their operation must always be interpreted in a statistical sense. New techniques to handle the model uncertainties in terms of the risk associated with the use of model outputs are needed to make these methods truly effective for water resources planning and design. (See also W71-01067) (Knapp-USGS)
W71-01081

RECENT DEVELOPMENTS IN MEASURING TECHNIQUES FOR FLOW IN OPEN CHANNELS,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 07B.
W71-01085

PRINCIPLES OF THE APPLICATION OF NUCLEAR TECHNIQUES TO HYDROLOGIC INVESTIGATIONS,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 07B.
W71-01086

NUCLEAR TECHNIQUES IN HYDROLOGY,
International Atomic Energy Agency, Vienna (Austria). Section of Hydrology.
For primary bibliographic entry see Field 07B.
W71-01087

POSSIBILITY OF FORECASTING THE AREAL WATER TEMPERATURE DISTRIBUTION,
M. G. Glagoleva.
Translation from Trudy GMTs, No 51, p 75-85, 1969. Soviet Hydrology: Selected Papers, Issue No 3, p 252-257, 1969. 6 p, 5 fig, 3 tab, 7 ref.

Descriptors: *Water temperature, *Forecasting, *Oceans, *Atlantic Ocean, *Areal, Surface waters, Atmospheric pressure, Meterological data, Fishing, Mathematical studies, Computer programs, Equations, Regression analysis, Foreign projects.
Identifiers: *Russia, North Atlantic.

Methods of utilizing hydrometerological data to forecast areal ocean-water temperatures (needed as an aid in the fishing industry) are described. A mathematical method of comparing the atmospheric pressure with the water temperature distribution in the North Atlantic from data collected on weather ships is emphasized. The ocean water temperature in summer is determined mainly by the state of the atmosphere in the preceding winter. Therefore, the distribution of water temperature anomalies at the surface in the North Atlantic in August was compared with the pressure field over the ocean and neighboring regions in January and February. The coefficients of expansion in series of natural components were used as the indexes of the water temperature and atmospheric pressure fields. Equations were obtained on an electronic computer for each coefficient of the field of water temperature anomalies by the method of multiple correlations. Similar equations for forecasting the coefficients of the field of water temperature anomalies were obtained for other months. The study shows not only that long-range water temperature forecasts can be issued for individual points, but also that the areal distribution of water temperature can be forecast. Related maps, graphs, and tables of data are included. (Woodard-USGS)
W71-01090

CAUSES OF LONG-PERIOD STREAMFLOW FLUCTUATIONS,
N. P. Smirnov.
Translation from (Izvestiya VGO), Vol 10, No 5, p 433-440, 1969. Soviet Hydrology: Selected Papers, Issue No 3, p 308-314, 1969. 7 p, 5 fig, 27 ref.

Descriptors: *Streamflow, *Fluctuation, *Climatic data, Solar radiation, Earth (Planet), Polarity, Atmosphere, Tides, Rivers, Flow rates, Gravity.
Identifiers: *Earth rotation, Volga River, Dnieper River (USSR).

Physiography factors and climatic conditions concerning causes of fluctuations in the supply of water and flow of rivers over long periods are discussed. The influences of extraterrestrial factors on climate are emphasized with relationship graphs constructed from data pertaining to the Volga and Dnieper Rivers in the USSR as follows: (1) Comparison of variations of the long-period part of the tide-producing force with flow anomalies of the

Volga at Volgograd, (2) comparison of variations in the long-period part of the tide-producing force with flow anomalies of the Dnieper at Kiev, (3) comparison of mean annual relative sunspot numbers with the flow anomalies of the Volga at Volgograd, (4) comparison of the Y component of the radius-vector of the pole of rotation of the earth in February with flow anomalies of the Volga at Volgograd, and (5) comparison of the Y component of the radius-vector of the pole of rotation of the earth in February with flow anomalies of the Dnieper at Kiev. The results indicate that flow fluctuations are governed largely through atmospheric circulation by variations in tide-producing forces, solar activity, and the forces of deformation arising from the nutational fluctuations of the pole of rotation of the earth. (Woodard-USGS)
W71-01091

APPROXIMATE ESTIMATE OF THE POSSIBLE UTILIZATION OF THE WATER RESOURCES OF KAZAKHSTAN,
P. F. Lavrent'yev, and L. D. Lavrent'yeva.
Translation from Trudy KazNIGMI, No 32, p 89-99, 1969. Soviet Hydrology: Selected Papers, Issue No 3, p 270-279, 1969. 10 p, 2 fig, 5 tab, 6 ref.

Descriptors: *Water supply, *Water resources, *Surface waters, *Water utilization, *Foreign projects, Rivers, Runoff, Streamflow, Reservoirs, Water yield, Water loss, Water storage, Precipitation (Atmospheric).
Identifiers: *Kazakhstan (USSR).

Data of developed projects for long-period storage reservoirs were used to estimate the surface water resources that can be practically utilized in Kazakhstan, U.S.S.R. The coefficient of flow utilization which characterizes the ratio of the maximum economically feasible volume of regulated net yield to the mean annual volume of the potential surface-water resources, was used as the conversion factor from potential surface-water resources to the resources that can be utilized in practice. The flow-utilization coefficient corresponds to a given probability of yield. Most of the large rivers of Kazakhstan are of importance to several republics and countries since the upper parts of their basins are located outside the borders of the republic. Therefore, in estimating the water resources of Kazakhstan that can be used in practice, allowance must be made for the requirements of neighboring republics and countries. Related maps, graphs, and tables of data are included. (Woodard-USGS)
W71-01092

FOREST HYDROLOGY AND EXTREME RAINFALL FREQUENCY,
Missouri Univ., Columbia. School of Forestry.
Carl D. Settergren.
Water Resources Bulletin, Vol 6, No 5, p 775-783, September-October 1970. 9 p, 6 fig, 1 tab, 2 ref.

Descriptors: *Rainfall, *Frequency analysis, *Forests, Rainfall-runoff relationships, Hydrograph analysis, Runoff forecasting, Streamflow forecasting, Peak discharge.
Identifiers: Forest hydrology, Rainfall extremes.

Extreme rainfall frequency analysis provides a means to predict the average time interval between the recurrences of storms of a specified duration and magnitude. This furnishes the forest hydrologist a valuable tool for engineering design and runoff and erosion forecast. A modification in the application of the annual maximum and annual exceedance series analysis described by V. T. Chow can, for special purposes, lead to an even more useful estimate of extreme events on a seasonal basis. This can be particularly important on small forested headwater watersheds where the runoff response to extreme rainfall may vary considerably with seasonal changes in canopy cover and soil moisture characteristics. Under certain circumstances, for short-term recurrence interval forecast and for non-critical application, the analysis of extreme rainfall frequency from less than 20 years data seems justified. (Knapp-USGS)
W71-01099

2B. Precipitation

PREDICTING AND MAPPING THE AVERAGE HYDROLOGIC RESPONSE FOR THE EASTERN UNITED STATES,
Georgia Univ., Athens.
For primary bibliographic entry see Field 02A.
W71-00551

DETACHMENT OF SOIL AGGREGATES BY SIMULATED RAINFALL,
Nebraska Univ., Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 02J.
W71-00556

SYNTHETIC GENERATION OF SEASONAL PRECIPITATION,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
Lourens A. V. Hiemstra, and Robert C. Creese.
Journal of Hydrology, Vol 11, No 1, p 30-46, July 1970. 17 p, 3 fig, 3 tab, 13 ref. OWRR Project A-015-PA.

Descriptors: *Precipitation (Atmospheric), *Synthetic hydrology, *Mathematical models, *Simulated rainfall, Rainfall, Hydrographs, Markov processes, Monte Carlo method, Stochastic processes, Probability, Statistical models, Rainfall intensity, Pennsylvania, Simulation analysis.
Identifiers: Synthetic rainfall series.

An analytical model was developed for the synthesis of seasonal point precipitation at State College, Pennsylvania. This model was based on statistical properties of precipitation events obtained from 27 years of historical data. The means and variances of important precipitation characteristics were reasonably well preserved in the synthesized data. These characteristics include precipitation amounts, precipitation durations, length of dry periods between occurrences of precipitation events, and parameters describing the time patterns of precipitation intensities. The model utilized lognormal and lognormal bivariate distributions of the precipitation characteristics of interest. The lognormal bivariate distributions enabled the preservation of interdependence between selected variables in a Monte Carlo type of generation process. The seasonal cycle in precipitation was defined by subdividing the 365 days of the year into one period of 60 days and five periods of 61 days each, starting at January 1 of each year. The one extra day in leap years was ignored. Time patterns of precipitation intensities were described by the incomplete beta-function. Precipitation events were arbitrarily separated when a period without precipitation lasted for or exceeded 30 min. (Knapp-USGS)
W71-00600

CLIMATIC ATLAS OF NORTH AMERICA MEAN SEA AND LAKE SURFACE TEMPERATURES,
Weather Wing (4th), Ent AFB, Colo.
For primary bibliographic entry see Field 07C.
W71-00784

OBJECTIVE FORECASTS OF PRECIPITATION USING PE MODEL OUTPUT,
Weather Bureau, Garden City, N.Y. Eastern Region Headquarters.
Stanley E. Wasserman.
Available from NTIS as PB-193 378, $3.00 in paper copy, $0.95 in microfiche. July 1970. 13 p. Technical Memorandum ER-35.
Identifiers: *Weather forecasting, Atmospheric precipation, Probability, Mathematical models, Humidity, Moisture, *Objective weather forecasting.

The National Meteorological Centers Primitive Equation (PE) Model predictions of relative humidity, relative humidity trend and vertical velocity are found to be well correlated to frequency of observed precipitation at New York City during the period November through March. A technique is developed for using these PE predicitions to objectively forecast probability of precipitation (PoP). The technique is shown to have applications to other areas.
W71-00802

AN EQUATION FOR VORTEX MOTION INCLUDING EFFECTS OF BUOYANCY AND SOURCES WITH APPLICATIONS TO TORNADOES,
National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center.
Robert C. Costen.
For sale by NTIS as NASA TND 5964, $3.00 in paper copy, $0.95 in microfiche. National Aeronautics and Space Administration Technical Note D-5964, October 1970. 62 p, 20 fig, 2 tab, 24 ref, 3 append.

Descriptors: *Tornadoes, *Vortices, *Equations, *Fluid mechanics, Hydrodynamics, Atmospheric pressure, Winds, Rotational flow, Mathematical models.
Identifiers: Jet stream effects (Atmospheric).

A new equation is derived for the motion of vorticity in a general fluid, including the effects of viscosity, compressibility, nonhomogeneity, and nonconservative forces. The equation holds, in particular, for vortices which may not move with the fluid. A linearized form of this equation is applied to tornado cyclones and to the twin tornado of April 11, 1965, near Elkhart, Indiana. It is shown that the displacement of tornado cyclones to the right of the mean tropospheric winds may be accounted for by the upward efflux of fluid from the cyclone into the jet stream. Also, the retarded revolution rate of the twin tornado may be due in part to an attractive 'buoyancy' force acting on the partially rarefied cores of the pair. (Knapp-USGS)
W71-00845

RAINFALL ENHANCEMENT BY DYNAMIC CLOUD MODIFICATION,
Environmental Science Services Admin., Miami Univ., Coral Gables, Fla.; and Atlantic Oceanographic and Meteorological Lab.
For primary bibliographic entry see Field 03B.
W71-00854

RIVERS OF DUST.

Chemistry, Vol 42, No 11, p 24, December 1969. 1 p, 1 fig.

Descriptors: *Dust storms, *Air circulation, *Fallout, Eluvium, Weather modification, Cloud seeding, Hurricanes, Atlantic Ocean, Cores, Sediment distribution, Satellites (Artificial), Remote sensing.
Identifiers: *Sahara Desert dust, Ocean sediments.

Red dust originating as dust storms on the Sahara Desert has been found in the atmosphere 3 mi above the Atlantic Ocean. The dust flows west with the trade winds, at a rate of about 15 mi per hour, until it reaches the Caribbean near Cuba about 3,000 mi away. There, it splits into three smaller streams; one crosses Central and South America, another the United States, and the third moves into the north Atlantic. The dust river may influence weather and even play a part in hurricane formation. Discovered accidentally in Barbados in 1965 by British scientists searching for cosmic dust, daily measurements show a peak during the summer, when large sand storms are more frequent in the Sahara. Satellite photographs show that it takes about a week for dust to travel from Africa to Barbados. In addition to being useful for tracing atmospheric patterns from satellites, the dust may lead to a better understanding of ocean sediments. Some cores from the Atlantic areas affected by the

dust river have shown material that can be traced to Africa. (Land-USGS)
W71-00886

ATMOSPHERIC AEROSOL: DOES A BACKGROUND LEVEL EXIST,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
William M. Porch, Robert J. Charlson, and Lawrence F. Radke.
Science, Vol 170, No 3955, p 315-317, October 16, 1970. 3 p, 1 fig, 1 tab, 13 ref.

Descriptors: *Aerosols, *Atmosphere, *Atmospheric physics, Air environment, Light penetration, Instrumentation, Data collections, Remote sensing, Measurement.
Identifiers: *Atmospheric aerosols, *Background level, World climate.

To determine a background level of atmospheric aerosol, for comparison with increases measured in the past 20 years and speculation on the effect of increasing aerosol on World climate, and for use in efforts to control air pollution, measurements of light-scattering were made at Point Barrow, Alaska, and Mount Olympus, Washington. These measurements agree in magnitude, and both sets of data are in agreement with other measurements of light-scattering and turbidity made in remote locations. Results suggest that a background level of aerosol does exist and that the concept of a background is applicable. Background values of the scattering component of the extinction coefficient of air are tabulated for 9 locations. Records are for varying time intervals from 1963 to 1970. The nephelometer was used at 5 of the locations, the Bolz sunphotometer at 3, and a searchlight at the other. (Lang-USGS)
W71-00910

CLOUD SEEDING, AREA OF EFFECT NUMERICAL MODEL,
Aerometric Research, Inc., Goleta, Calif.
Robert D. Elliott.
Report, January 1969, revised. 67 p, 12 tab, 27 fig, 19 ref, 3 append.

Descriptors: *Cloud seeding, *Numerical models, *Precipitation (Atmospheric), *Weather modification, Model studies, Weather patterns, Weather forecasting, Storms, Storm structure.

A computerized numerical seeding area of effect model is presented for the orographic winter storm situation. The required inputs are: Vertical profile of wind, temperature, and moisture in the air mass approaching the barrier; The artificial nucleant source strength production curve, and position; Topographic data over the area of interest. Outputs include an outline of the area in which seeding will enhance precipitation. The model handles both the laminar flow and the convection cases. Drift, diffusion, nucleation, growth and fallout from the ground plume is predicted. The model includes a nuclei/water vapor/liquid water/ice/precipitation budget. Growth by both diffusion and accretion is maintained. In the case of convection, growth and fallout of precipitation particles from a tilted convection column to the ground is predicted. A prediction can also be made for an aerial source. Provision is made for reading out in 50-second computational steps the status of all parameters within the ground plume, convection columns, and the fallout therefrom to ground level. The model produces results in accord with information gleaned from seeding test projects. It also successfully predicts the temperature dependent division into positive and negative effects found by Grant and Mielke in their statistical analysis of seeding effects in the Rockies.
W71-00912

PROBABLE MAXIMUM PRECIPITATION, MEKONG RIVER BASIN,
Environmental Science Services Administration, Washington, D.C.
John T. Riedel, and Francis K. Schwartz.
For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price $1.25. Hydrometeorological Report, No 46, May 1970. 152 p, 60 fig, 71 ref, append.

Descriptors: Design flood, Maximum probable flood, *Precipitation, Spillways, *Probable maximum precipitation, Weather patterns, Storms.
Identifiers: Typhoon rainfall, *Mekong River Basin, Cambodia, Laos, Thailand, Vietnam, China, *Rainfall climatology.

This study is divided into two main parts. The first gives generalized estimates of probable maximum precipitation (PMP) for the Mekong River Basin south of the China border. Drainage areas covered range from 5000 to 25,000 km (2) in size. The prototype to the PMP storm is a typhoon crossing the Vietnam coast into the Mekong River Basin. The second part gives rainfall estimates for calculating the probable maximum flood at three potential dam sites on the Mekong River. These sites and the drainages involved are Luang Prabang, Laos, 262,000 km (2), Pakse, Laos, 539,000 km (2) and Kratie (Sambor) Cambodia, 646,000 km (2). The criteria for these large basins consist of rainfall frequencies over large subareas for the entire southwest monsoon rainy season, and portions thereof, along with rainfall from two critically-spaced typhoons. (Thompson-ESSA)
W71-00945

THE FULL-GLACIAL CLIMATE IN THE SOUTHWESTERN UNITED STATES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia).
For primary bibliographic entry see Field 02C.
W71-00947

FOREST HYDROLOGY AND EXTREME RAINFALL FREQUENCY,
Missouri Univ., Columbia. School of Forestry.
For primary bibliographic entry see Field 02A.
W71-01099

THE ISOLATION OF RANDOM ERRORS IN PERIODIC RAINFALL,
Calgary Univ., Alberta. Dept. of Geography.
For primary bibliographic entry see Field 07C.
W71-01100

2C. Snow, Ice, and Frost

DIRECT READING FROST GAGE IS RELIABLE, INEXPENSIVE,
Forest Service (USDA), St. Paul, Minn. North Central Forest Experiment Station.
For primary bibliographic entry see Field 07B.
W71-00913

THE USE OF ENVIRONMENTAL SATELLITE DATA FOR MAPPING ANNUAL SNOW-EXTENT DECREASE IN THE WESTERN UNITED STATES,
Allied Research Associates, Inc., Concord, Mass.
James C. Barnes, and Clinton J. Bowley.
Final report for the Environmental Science Services Administration, June 1970. 105 p, 6 tab, 16 fig, 10 ref, append.

Descriptors: *Snow cover, *Snowmelt, *Snow surveys, *Remote sensing.
Identifiers: Satellite data, Columbia River Basin, Salt River Basin, Southern Sierra Nevada Region.

Techniques to map areal snow extent from satellite photography were tested during the 1967 and 1969 snowmelt seasons in three regions of characteristically different terrain, forest cover, and snowfall climatology in the western United States. Principal data sample used was AVCS photography from ESSA satellites. Also examined were IDCS photographs and Daytime HRIR data from the Nimbus III satellite. Snow-extent measurements from aerial surveys were used as ground-truth data. Results indicate that of the three regions tested satellite imagery provides the most reliable measurements of snow extent in the southern Sierra Nevada in California. For typical river basins in this region, snow extent in terms of percentage of basin covered can be determined to within plus or minus 5% of the aerial-survey measurement. In the Upper Columbia Basin in Idaho and Montana, satellite snow mapping is less reliable because of excessive springtime cloudiness and more densely forested mountain ranges with less horizontal snow-cover extent. In the Salt River Project Area in Arizona shallower snow depths can be mapped because of the sparse vegetation. (Thompson-ESSA)
W71-00946

THE FULL-GLACIAL CLIMATE IN THE SOUTHWESTERN UNITED STATES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia).
Robert W. Galloway.
Association of American Geographers, Annals, Vol 60, No 2, p 245-256, June 1970. 5 fig, 4 tab, 64 ref.

Descriptors: *Glacial soils, *Playas, *Hydrologic cycle, *Climatic data, *Paleoclimatology, Evaporation, Precipitation (Atmospheric), Runoff, Lakes, Solifluction, Arizona, New Mexico, Arid lands, Temperature, On-site investigations, Southwest U.S., Inflow, Climatology.
Identifiers: *Pluvial climate, *Full-glacial lakes, *Periglacial solifluction deposits, *Lake formation.

Studies on full-glacial closed lakes in the Southwestern U.S. have led to the general conclusion that the last glacial period (23,000-17,000 B.P.) had a generally wet, pluvial climate. Temperatures of the period may be estimated from periglacial solifluction deposits which indicate mean summer temperatures 10 degrees (centigrade) lower than the present arid climate and mean winter temperatures 11 degrees lower. In order to evaluate the significance of this and other full-glacial climatic data in terms of the hydrologic cycle, 8 conservative assumptions were made relating temperature, lake evaporation and inflow, precipitation and runoff. The validity of these assumptions are discussed in terms of existing data. Precipitation on several full-glacial lakes in Arizona and New Mexico was calculated from estimates of evaporation and inflow. It appears that as a result of the prevailing low temperatures, precipitation was somewhat less than present levels, but evaporation was less than one-half, and the large differences between the two led to lake formation. Although the evidence is still inconclusive, it is felt that the theory of pluvial conditions is probably incorrect. (Casey-Arizona)
W71-00947

SNOW COVER EVAPORATION IN THE SEMIDESERT ZONE OF KAZAKHSTAN,
For primary bibliographic entry see Field 02D.
W71-01093

2D. Evaporation and Transpiration

EXTRACTION TERM MODELS OF SOIL MOISTURE USE BY TRANSPIRING PLANTS,
Stanford Univ., California.
For primary bibliographic entry see Field 02I.
W71-00586

ON THE WATER BALANCES OF SOME INDIAN STATIONS,
Meteorological Office, Poona (India).
B. Padmanabhamurty, C. V. V. Satyanarayana Rao, and J. Dakshinamurti.
Journal of Hydrology, Vol 11, No 2, p 169-184, August 1970. 16 p, 1 fig, 11 tab, 16 ref.

Descriptors: *Evapotranspiration, *Water balance, *Humid areas, *Tropical regions, Humid climates, Arid lands.
Identifiers: India.

Water balances of some Indian stations situated in various climatic zones have been evaluated by employing the Potential Evapotranspiration values of Thornthwaite and Penman. Annual Potential Evapotranspiration of many stations is higher in the case of Thornwaite than Penman; sometimes to an extent of 26%. (Knapp-USGS)
W71-00595

HEAT AND MASS TRANSFER IN A CHANNEL WITH SURFACE MASS ADDITION: APPLICATION TO PHASE CHANGE PROCESSES,
Minnesota Univ., Minneapolis.
E. M. Sparrow, and H. S. Yu.
AIChE Journal, 16, No 4, 1970, p 588-594. 9 fig, 7 ref.

Descriptors: *Heat transfer, *Mass transfer, Channel flow, Evaporation, Air-water interfaces, Turbulence, Air temperature, Hydraulic water temperature, Thermal properties, Heat budget, Properties, Diffusion properties, Density, Momentum transfer, Reynolds number, Turbulent flow.
Identifiers: Fluid mechanic slushes.

The heat and mass transfer processes in a binary mixture flowing in a parallel plate channel with mass addition at the bounding surfaces are investigated analytically. The rate of mass addition, the temperature, and the mass fraction are arbitrarily prescribed at each of the bounding walls. Similarity solutions are evaluated numerically to yield pressure gradient, Nusselt number, and Sherwood number results for a wide range of each of three governing parameters. Increasingly strong surface mass addition markedly increases the magnitude of the axial pressure gradient. Mass addition decreases the Nusselt and Sherwood numbers at the channel wall at which the injection is strongest but may actually increase these moduli at the opposite wall. A generalizing analysis is performed to accommodate phase change processes as well as to accommodate the specification of plenum conditions rather than wall surface conditions. Application is made to the evaporation of liquid water by air stream. The rate of evaporation is augmented as the rate of air injection increases, but the extent of the augmentation is less than the causative increase in the air flow rate. (Novotny-Vanderbilt)
W71-00655

HYDRODYNAMIC STABILITY OF BOUNDARY LAYERS WITH SURFACE MASS TRANSFER,
Drexel Univ., Philadelphia, Pennsylvania.
F. K. Tsou, and E. M. Sparrow.
Applied Scientific Research, Vol 22, No 314, p 273-286, May 1970. 1 tab, 5 fig, 9 ref.

Descriptors: *Mass transfer, *Heat transfer, *Boundary layers, Air-water interfaces, Evaporation, Energy transfer, Convection, Reynolds number, Laminar flow, Turbulent flow, Turbulence.
Identifiers: Mass transfer theory, Heat transfer theory.

The linear stability of the flat plate boundary layer with surface blowing and suction is investigated by the application of numerical techniques. Complete neutral stability curves, critical Reynolds numbers and wave numbers, and other stability characteristics are determined for a wide range of surface mass transfer intensities. The critical Reynolds number, based on the displacement thickness, is found to vary from 59 to 32500 between the extreme limits of blowing and suction that are investigated. Comparisons are made between the present results and available linear stability information for boundary layers with surface mass transfer and with free-stream pressure gradients. The universal stability bound of Joseph is evaluated and compared with the corresponding numerically exact neutral stability curve. (Novotny-Vanderbilt)
W71-00658

ACTUAL EVAPOTRANSPIRATION AS DETERMINED FROM SOIL-WATER AND CANOPY CHARACTERISTICS AND POTENTIAL EVAPOTRANSPIRATION,
Wisconsin Univ., Madison. Dept. of Soil.
C. B. Tanner, and W. R. Gardner.
Available from NTIS as PB-193 149, $3.00 in paper copy, $0.95 in microfiche. Progress Report, June 1970. 65 p. ESSA Grant E-287-68 (G).
Identifiers: *Evapotranspiration, Predictions, *Plants (Botany), Evapotranspiration, *Soils, Plant tissue, Moisture, Site selection, Water, Vegetables, Energy, Seeds, Atmospheric temperature, Heat flux, Production, Agriculture, Irrigation systems, Stress (Physiology), Plant canopy, Onion plants, Heat budget.

Transpiration and evaporation from a sparsely populated onion field were computed separately from measured evapotranspiration, potential evaporation, stomatal resistances and leaf area indices. Transpiration also was calculated independently from measured stomatal resistance, air vapor pressure, plant-temperature and wind. Daily transpiration estimates found by these two methods agree within 5 percent. The transpiration was only about 25 percent of total evapotranspiration. This field, which was at 1/3-normal population, would transpire at proportionately greater rate if population were increased to normal; however, measurements show that soil evaporation decreases so that evapotranspiration would increase only about 15 percent. The portion of transpiration accounted for by each plant part was 3 percent for umbels, 42 percent for leaves and 55 percent for scapes.
W71-00818

EVAPORATION OF GROUNDWATER FROM COASTAL PLAYAS (SABKHAH) IN THE ARABIAN GULF,
Raikes and Partners, Rome (Italy).
J. G. Pike.
Journal of Hydrology, Vol 11, No 1, p 79-88, July 1970. 10 p, 2 fig, 3 tab, 3 ref.

Descriptors: *Evaporation, *Brines, *Playas, *Deserts, *Groundwater movement, Saline water systems, Water table, Water levels, Salt marshes, Coastal marshes, Evaporation pans.
Identifiers: Sabkhah, Arabian Gulf, Groundwater evaporation.

A sabkhah (plural: sibakh) is a coastal or inland saline mud flat or playa. They are commonly saturated with brine and are often salt encrusted. These sibakh occur in a belt, some 50 km in width, along the southern coast of the Arabian Gulf, extending from Kuwait to the Gulf States. During and after infrequent winter rainfall, these areas may sometimes flood for short periods. Much of the ponded water is lost to evaporation. Many sibakh have shallow water tables at depths of between 0.5 and 1.0 m, and show very little variation with time. A regional groundwater study of the eastern coastal belt of The Gulf suggests that the sibakh complex is either an evaporation sink for rising groundwater or that their water tables are perched. Net radiation, air temperature, vapor pressure, both dry and wet bulb temperatures, surface temperature, and windspeed records were collected. These data were then used to calculate the energy balance. Evaporation is taking place at a constant proportion of the energy income and from a constant depth to water table. Evaporation of groundwater from these sibakh is large and important in an area of limited water resources. (Knapp-USGS)
W71-00865

THE EFFECT OF NITROGEN SUPPLY ON TRANSPIRATION AND STOMATAL BEHAVIOUR OF BEANS (PHASEOLUS VULGARIS L.),
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
Daniel Shimshi.
New Phytologist, Vol 69, No 2, p 405-412, April 1970. 1 fig, 2 tab, 8 ref.

Descriptors: *Nitrogen, *Transpiration control, *Soil-water-plant relationships, *Stomata, *Moisture deficit, Leaves, Beans, Laboratory tests, Soil moisture, Plant physiology, Arid lands, Wilting point, Deserts, Moisture stress.
Identifiers: *Nitrogen deficit, Primary leaves, Trifoliate leaves, Desert soils, Seedlings, Negev Desert.

Arid lands are generally characterized by low soil N levels. Potted bean seedlings were grown and maintained in low-N Negev Desert soil and half were fertilized with N. The N-supplied plants exhibited normal leaf habits while only the primary leaves of the N-deficient leaves were green. With high soil moisture (14-20 percent) transpiration rates were highest in N-supplied plants, but on approaching the wilting point (7-10 percent) they dropped below the N-deficient plants. The stomata appeared closed, but coating with vapor-impervious compounds revealed they were open but below microscopic resolution and could be experimentally induced to much greater apertures. Apparently moisture stress occurs even at 17-20 percent soil moisture. When stomata were fully open, apertures were smaller in N-deficient plants but transpiration rates were comparable in all plants at higher levels of plant hydration. It was tentatively concluded that: (1) N-deficient plants cannot achieve normal stomatal openings and (2) The degree of leaf hydration probably effects some control on transpiration rates independently of stomatal control. (Casey-Arizona)
W71-00956

THE EFFECT OF NITROGEN SUPPLY ON SOME INDICES OF PLANT-WATER RELATIONS OF BEANS (PHASEOLUS VULGARIS L.),
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
Daniel Shimshi.
New Phytologist, Vol 69, No 2, p 413-424, April 1970. 3 fig, 2 tab, 21 ref.

Descriptors: *Nitrogen, *Transpiration control, *Soil-water-plant relationships, *Stomata, *Moisture deficit, Laboratory tests, Beans, Leaves, Chlorophyll, Electrolytes, Plant physiology, Soil moisture, Wilting.
Identifiers: *Nitrogen deficiency, Primary leaves, Trifoliate leaves, Sap solutes, Seedlings, Sap, Sugar, Desert soils.

In N-supplied single bean seedling leaves chlorophyll content was high and stomatal apertures were wide open while corresponding values for N-deficient leaves were 50 percent or less. At high soil moistures N-supplied trifoliate transpiration rate leaf values were higher than primary leaf values but dropped faster with decreasing soil moisture. In N-deficient plants the situation was reversed and both types of leaf had lower values than N-supplied plants. The differences were ascribable to 3 interacting factors: (1) Soil moisture, (2) Leaf age and (3) N-status. Apparently stomata in N-deficient leaves fail to close as tightly as those of N-supplied leaves, accounting for their higher transpiration rates in drier soils. Below 9 percent soil moisture, N-supplied plants exhibited clear wilting symptoms never seen in N-deficient plants. N-supplied plants had consistently higher electrolyte and sap sugar levels in all ranges of soil moisture. Apparently N-deficiency inhibits sap sugar content response to moisture stress onset. Various theories concerning the mechanisms of these effects are discussed and it is concluded that the plant's abilities to regulate stomatal opening and sap-solute concentrations are affected by N-deficiency. (Casey-Arizona)
W71-00957

SNOW COVER EVAPORATION IN THE SEMIDESERT ZONE OF KAZAKHSTAN,
S. P. Rylov.

Translation from Trudy KazNIGMI, No 32, p 64-77, 1969. Soviet Hydrology: Selected Papers, Issue No 3, p 258-270, 1969. 13 p, 3 fig, 8 tab, 29 ref.

Descriptors: *Evaporation, *Snow cover, *Foreign projects, Runoff, Vapor pressure, Snowmelt, Soil moisture, Statistical methods, Correlation analysis, Precipitation (Atmospheric), Meteorological data, Air temperature, Humidity, Hydrology, Wind velocity, Topography.
Identifiers: *Semidesert zone, *Kazakhstan (USSR).

Observational data of the West Kazakhstan runoff station for a 14-year period (1952-65) were used to estimate snow evaporation in winter and spring in the semidesert zone of Kazakhstan U.S.S.R. Two types of relationships were constructed on the basis of measurements of snow evaporation and average meteorological elements (temperature, absolute humidity, and vapor pressure deficit). The first of these included the relationship between snow evaporation and air temperature and absolute humidity, and the second was constructed from the relationship between snow evaporation and the vapor pressure deficit. Results indicate the following: (1) the rate of evaporation from snow is 0.09-0.12 in winter and 0.40-0.60 mm/day in spring; (2) the computed evaporation from snow in the December-March period ranges from 15 mm in the north to 25-30mm in the south; (3) the losses in snow storage through evaporation are 15% in winter, and 5% for the nonreduced evaporation depth and 18% for the reduced evaporation depth during the snow melting period; (4) verification of the existing methods of computing evaporation from snow in the semidesert zone of Kazakhstan showed that the most accurate and simple method of computing it is that based on the vapor pressure deficit. (Woodard-USGS)
W71-01093

2E. Streamflow and Runoff

PREDICTING AND MAPPING THE AVERAGE HYDROLOGIC RESPONSE FOR THE EASTERN UNITED STATES,
Georgia Univ., Athens.
For primary bibliographic entry see Field 02A.
W71-00551

WATER RESOURCES INVESTIGATIONS IN THE SUSQUEHANNA RIVER BASIN,
Geological Survey, Harrisburg, Pa.
L. V. Page, and P. R. Seaber.
Pennsylvania Department of Forests and Waters Technical Bulletin No 2, 1970. 1 sheet, 2 tab, 1 map.

Descriptors: Water resources, *Surface waters, *Groundwaters, *Sedimentation, Water quality, Hydrology, Acidity, Geology, Aquifers, Pennsylvania.
Identifiers: *Hydrologic atlas, *Susquehanna River basin.

Active areal projects in the Susquehanna River basin operated by the U.S. Geological Survey (WRD) in cooperation with other agencies are shown on this hydrologic atlas as follows: (a) Hydrology and sedimentation of the Corey Creek and Elk Run watersheds; (b) surface-water quality of the West Branch Susquehanna River basin; (c) acidity of Beech Creek; (d) surface-water quality of the West Branch Susquehanna basin in the vicinity of Curwensville, Pa.; (e) water quality of the Susquehanna River at Danville, Pa.; (f)Hydrology and sedimentation of the Bixler Run watershed; (g) water resources of the Swatara Creek basin; (h) geology and hydrology of the Martinsburg shale in central Dauphin County, Pa.; (i) variations in the chemical character of the Susquehanna River at Harrisburg, Pa.; (j) hydrology of limestones in the Lebanon Valley; (k) hydrology of the New Oxford Formation in Adams and York Counties, Pa.; (l) hydrology of the New Oxford Formation in Lancaster County, Pa.; (m) hydrology of the Carbonate Rocks of the Lancaster quadrangle, Lancaster County, Pa.; (n) hydrology of the metamorphic and igneous rocks of Central Chester County, Pa.; and (o) reconnaissance of the Chemical Quality of Maryland Streams. Listed are 150 selected reports devoted exclusively to or containing data on water in the Susquehanna River basin. (Woodard-USGS)
W71-00564

WATER RESOURCES INVESTIGATIONS IN THE UPPER OHIO RIVER BASIN,
Geological Survey, Harrisburg, Pa.
C. J. Rossow, and M. B. Coll, Jr.
Pennsylvania Department of Forests and Waters Technical Bulletin No 1, 1970. 1 sheet, 2 tab, 1 map.

Descriptors: Water resources, *Groundwater, *Surface waters, Water quality, Geology, Aquifers, Hydrology, Pennsylvania.
Identifiers: *Hydrologic atlas, *Upper Ohio River basin, Acid mine drainage.

Active areal projects in the Upper Ohio River basin operated by the U. S. Geological Survey (WRD) largely in cooperation with other agencies, are shown on this hydrologic atlas as follows: (a) Ground-water resources, Allegheny River basin and part of the Lake Erie basin, New York; (b) surface-water resources of the Allegheny River basin and part of the Lake Erie basin, New York; (c) chemical quality of streams, Allegheny River basin, New York; (d) geology and ground-water resources of western Crawford County; (e) geology and ground-water resources of the Shenango and Stoneboro quadrangles; (f) investigation of principal aquifers in northeastern Ohio; and (g) Roaring Creek-Grassy Run acid mine drainage study. Listed are 255 selected reports regarding water-resources investigations or containing data on water in the Ohio River basin and 45 selected references on hydrology. (Woodard-USGS)
W71-00566

RECESSION AND THE BASEFLOW PROBLEM,
Imperial Coll. of Science and Technology, London (England).
F. Victor Appleby.
Water Resources Research, Vol 6, No 5, p 1398-1403, October 1970. 6 p, 1 fig, 22 ref.

Descriptors: *Recession curves, *Base flow, *Reviews, Bibliographies, Surface-groundwater relationships, Discharge (Water), Recharge, Rainfall-runoff relationships, Streamflow, Hydrograph analysis.
Identifiers: Base flow calculation.

Baseflow is discussed as a hydrograph component, with special reference to a 1968 review paper, 'Base-Flow Recession.' Additional references with particular emphasis on the baseflow problem are given. A three parameter baseflow partition functional is shown to give substance to the concept of 'group persistence' and to suggest an underlying mechanism to the Hurst statistical phenomenon. (Knapp-USGS)
W71-00577

MEASURING FLOW THROUGH CREST GATES,
Corps of Engineers, Pittsburgh, Pa.
For primary bibliographic entry see Field 07B.
W71-00582

PARTIAL AREA CONTRIBUTIONS TO STORM RUNOFF IN A SMALL NEW ENGLAND WATERSHED,
Agricultural Research Service, Danville, Vt.
For primary bibliographic entry see Field 02A.
W71-00588

MODELING THE EFFECT OF LAND USE MODIFICATIONS ON RUNOFF,
Agricultural Research Service, Brookings, S. Dak.; and Water Resources Board, Reading (England).
For primary bibliographic entry see Field 04C.
W71-00589

NONLINEAR TIME VARYING MODEL OF RAINFALL-RUNOFF RELATION,
Pittsburgh Univ., Pa.
For primary bibliographic entry see Field 02A.
W71-00590

RIVER FLOW FORECASTING THROUGH CONCEPTUAL MODELS, PART III – THE RAY CATCHMENT AT GRENDON UNDERWOOD,
Institute of Hydrology, Wallingford (England).
A. N. Mandeville, P. E. O'Connell, J. V. Sutcliffe, and J. E. Nash.
Journal of Hydrology, Vol 11, No 2, p 109-128, August 1970. 20 p, 9 fig, 2 tab, 6 ref.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Streamflow forecasting, Routing, Soil moisture, Antecedent precipitation, Hydrologic budget, Water balance, Statistical models.
Identifiers: Ray watershed (England).

Methods of modeling the runoff process on the Ray catchment, England, are described. These depend on soil moisture accounting and simple descriptions of the generation of runoff and of routing. It is found possible, with simple models, to account for about 90 percent of the initial variance of runoff volumes and about 75 percent of the initial variance of the discharge rate. (Knapp-USGS)
W71-00591

THE MEASUREMENT OF THE EFFECTS OF BUILDING CONSTRUCTION ON DRAINAGE BASIN DYNAMICS,
Exeter Univ. (England).
For primary bibliographic entry see Field 04C.
W71-00592

THE CENTRAL AUSTRALIAN STREAM FLOODS OF FEBRUARY-MARCH 1967,
Adelaide Univ. (Australia). Dept. of Geology.
George E. Williams.
Journal of Hydrology, Vol 11, No 2, p 185-200, August 1970. 16 p, 6 fig, 4 tab, 11 ref.

Descriptors: *Floods, *Deserts, *Arid lands, *Historic flood, Stage-discharge relations, Hydrologic data, Data collections, Sediment transport, Sedimentary structures, Flood damages, Turbulent flow, Critical flow, Velocity.
Identifiers: *Australia.

Between Feb. 5 and Mar. 8, 1967, central Australia received some of its heaviest rains on record. Derived from three separate southward intrusions of monsoonal weather, the rains gave total gagings of 120-350 mm, with some stations receiving overnight falls of over 150 mm. The ensuing floods were the most devastating in the western Lake Eyre basin in living memory. Accurate hydrological data are available only for the Todd and Finke rivers. During the 1967 floods the Todd attained a maximum gage height of 2.17 m and a mean velocity of 1.95 m/sec; the Finke, a maximum gage height of 6.95 m. Other major streams flooded to depths of 3-5 m and locally spread to widths of several kilometers. On March 15, floodwaters were observed entering Lake Eyre by way of the Macumba and the Neales. Finke waters did not reach Lake Eyre, being absorbed by the sands of the Simpson Desert. Large-scale ripples (dunes) were preserved on most sand-bed channels at the recession of the floods, indicating that subcritical flow prevailed for most streams. By estimating the Froude number and the Darcy-Weisbach resistance coefficient for large-scale ripples, mean stream velocities of about 0.8-2.8 m/sec have been calculated for such chan-

nels. In contrast, flat-bedded sand with parting lineation was deposited in the middle reach of the Finke. It is estimate d that there the Finke attained a mean velocity of about 3 m/sec and a peak discharge of about 1200 cu m/sec. (Knapp-USGS)
W71-00596

RIVER DISCHARGE MEASUREMENT BY THE RISING FLOAT TECHNIQUE,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Meteorological Physics.
For primary bibliographic entry see Field 07B.
W71-00597

THE ROLE OF MIXING IN STRATIFIED FLOWS - AN ANNOTATED BIBLIOGRAPHY,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
N. Hayakawa, and F. R. Schiebe.
FWQA Grant. St. Anthony Falls Hydraulic Laboratory, No IM-93, October, 1968.

Descriptors: *Abstracts, *Thermal stratification, *Bibliographies, Interfaces, Hydrodynamics.

Concurrently with a research program concerned with mixing at the interface of a three-dimensional thermally stratified flow, a literature search was conducted. Abstracts of 163 papers dealing with the hydrodynamics of stratified flow were assembled in alphabetical order according to authors. The bibliography is not intended to be complete. The material was compiled in 1966 and contains material published that year and published prior to 1966. (Osborne-Vanderbilt)
W71-00650

STREAMFLOW SYNTHESIS FOR UNGAGED RIVER,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Leo R. Beard.
Tech Paper No 5, The Hydrologic Engineering Center, Corps of Engineers, US Army, Sept-Oct 1967. 14 p, 6 tab, 4 ref.

Descriptors: *Mathematical models, *Simulation analysis, *Streamflow, *Monthly.
Identifiers: Model coefficients.

A mathematical model for simulating monthly streamflow, developed by the Hydrologic Engineering Center of the Corps of Engineers was described Model coefficients for each of the 12 calendar months and number 48 for a single location. For the purpose of deriving a monthly streamflow model for ungaged locations, these coefficients were combined into a small number of generalized coefficients, which can feasibly be related to drainage basin characteristics. Generalized coefficients for simulating monthly streamflows were developed with the requirement that important characteristics of flows generated using the generalized coefficients compared reasonably with those characteristics of recorded data at long-record stations throughout the United States. Means of establishing generalized model coefficients and generating hypothetical streamflows for ungaged locations were described. The generalized model required 4 statistics for use at a single station. These were indexes of wet-season average flow, dry season average flow, flow variation from year to year, and flow persistence from month to month. The statistics represented the important characteristics of streamflow and were designed so that any amount and type of information could be used in their estimation. (Kriss-Cornell)
W71-00709

SIMULATION OF DAILY STREAMFLOW,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Leo R. Beard.
Tech Paper No 6, The Hydrologic Engineering Center, Corps of Engineers, US Army. 13 p, 5 tab, 4 ref.

Descriptors: *Simulation analysis, *Mathematical modes, *Computer programs, *Markov processes, *Streamflow, Monthly, Stations.

Generation of daily streamflow for a location where daily flow records existed and where monthly total flows for the periods of generation were given was accomplished by two elaborate computer programs usable in high-speed computers. The model described was based on adequate representation of daily streamflow variations at the 7 selected stations listed. Data used for tests of the model were limited to the 7 stations. The procedure was based on generation of monthly streamflows and subsequent allocation of the monthly total amounts to each day. The monthly streamflow generator used was developed in the Hydrologic Engineering Center of the Corps of Engineers and for a single station it consisted of a simple Markov chain, with each flow consisting of a random component and a component correlated with the preceding month's flow. The mathematical model used for daily streamflow simulation consisted of a second order Markov chain, using standardized variates. Results for the 7 stations used were summarized. A summary of the procedure and a test of the over-all results was given. (Kriss-Cornell)
W71-00715

THE MATHEMATICAL SIMULATION OF THE HYDROLOGY OF SMALL WATERSHEDS,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
L. F. Huggins, and E. J. Monke.
Purdue University Water Resources Research Center, Lafayette, Indiana, Tech Rep No 1, Aug 1966. 130 p, 19 fig, 5 tab, 3 append, 52 ref.

Descriptors: *Mathematical models, *Hydrology, *Digital computers, *Hydrographs, *Simulation analysis, Watershed management, Runoff.

A mathematical model which integrated the relationships for various hydrologic components of runoff at all points in a watershed to obtain the runoff hydrograph for a complete area was proposed. The procedure consisted of the development of relationships describing the runoff dynamics for very small elemental areas or points within the watershed. Quantitative relationships were suggested for five of the basic hydrologic components which described the runoff processes: interception, infiltration, depression storage or surface retention, surface detention and surface runoff. A general purpose digital computer program, written in Fortran IV was developed to evaluate the resulting mathematical watershed model. The ability of the proposed watershed model to simulate observed runoff hydrographs from small (two acre) watersheds was investigated for several storm events. The model was capable of simulating complex storm events very satisfactorily. A comparison between the runoff hydrograph predicted for each storm event by the synthetic hydrograph analysis and the proposed model was made. The sensitivity of the predicted hydrographs of selected storm event to changes in the values of the assumed initial parameters was reported. (Kriss-Cornell)
W71-00720

RUNOFF ROUTING THROUGH STEEP NATURAL CHANNELS,
Research Council of Alberta, Edmonton.
For primary bibliographic entry see Field 08B.
W71-00842

GEOMETRIC AND FRICTIONAL EFFECTS OF SUDDEN RELEASES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W71-00843

THROUGHFLOW ON HILLSLOPES AND ITS RELATION TO THE STREAM HYDROGRAPH,
Bristol Univ. (England).
For primary bibliographic entry see Field 02G.
W71-00858

AN UNCONVENTIONAL APPROACH TO FLOOD FREQUENCY ANALYSIS,
Technion - Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 02A.
W71-00861

ON THE COMPUTER EVALUATION OF THIESSEN WEIGHTS,
Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center.
For primary bibliographic entry see Field 02A.
W71-00864

SOME ASPECTS OF THE AVAILABILITY OF WATER FROM THE EVERGLADES TO THE EVERGLADES NATIONAL PARK, FLORIDA,
Geological Survey, Tallahassee, Fla.
J. H. Hartwell.
Geological Survey Open-file Report 70007, September 1970. 36 p, 10 fig, 2 tab, 7 ref.

Descriptors: *Florida, *Water sources, *Swamps, Surface drainage, *Rainfall-runoff relationships, *Depth-area-curves, Surface waters, Streamflow, Canals, Levees, Stream gages, Flow rates, Discharge measurement, Flow characteristics, Water management (Applied), Discharge (Water).
Identifiers: *Everglades, *Everglades National Park (Florida).

Hydrologic information was evaluated to determine the source of water in south Florida that flowed from the north into Everglades National Park. In particular, consideration was given to overland flow of water to the park. A comparison was made of discharges at several locations for two, 12-year periods, 1940-51 and 1952-63. The first period was prior to the construction of water control works for the Central and Southern Florida Project. The second period covered the time during which control works were progressively being built. Discharge from Lake Okeechobee to the Everglades was 5.4 million acre-feet for the period 1940-51 and 1.5 million acre-feet during 1952-63. In spite of the reduction in flow from Lake Okeechobee to the Everglades in the second period, the flow to the Everglades National Park into the Shark River Slough was 2.7 million acre-feet greater in the second period than during the first period. An increase in rainfall on Conservation No. 3 in the period 1952-63 probably contributed significantly to the increased discharge to Shark River Slough, but some of the increase in discharge apparently resulted from new control works of the Central and Southern Florida Project, which reduced flow to the sea through the coastal canals. Related maps, graphs, and tables of data are included. (Woodard-USGS)
W71-00880

LOW-FLOW FREQUENCIES OF ILLINOIS STREAMS,
Geological Survey, Washington, DC.
Oscar G. Lara.
Illinois Department Public Works and Buildings, Division of Waterways Report, 1970. 317 p, 11 fig, 6 tab, 11 ref.

Descriptors: *Low flow, *Frequency, *Streamflow, *Illinois, Data collections, Hydrologic data, Frequency analysis, Statistical methods, Streamflow forecasting, Duration curves.
Identifiers: Low-flow frequency.

This report contains low-flow data and regionalized low-flow frequency curves for all areas in Illinois where at least five years of record (through 1956) have been collected. Minimum average flows for periods of 1, 7, 15, 30, 60, 120, and 183 days are tabulated for the benefit of those who are in-

terested in the amount of flow available in the stream with minor or no storage. Data for 12, 24, and 60 months are also included in the tables for those concerned with the minimum expected inflow into large impounding reservoirs. Six separate regionalized frequency curves for each station have been fitted on the plotted data. These curves evaluate the minimum average flow expected in periods of 7, 15, 30, 60, 120, and 183 days, respectively. A technique is derived to serve as a guide in fitting frequency curves to observed data on a regionalized basis, and for the purpose of extrapolating short-term records. This technique is based on relations empirically developed between low-flow and flow-duration parameters. (Woodard-USGS)
W71-00884

WATER RESOURCES OF THE CENTRAL NEW YORK REGION,
Geological Survey, Albany, N.Y.
William G. Weist, Jr., and G. L. Giese.
New York Water Resources Commission Bulletin 64, 1969. 58 p, 21 fig, 2 plate, 3 tab, 22 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, New York, Hydrologic cycle, Streamflow, Flow rates, Geology, Geologic formations, Aquifers, Bedrock, Water quality, Water resources development, Regional flood, Groundwater recharge, Irrigation, Water pollution.
Identifiers: Water-related problems, Streamflow extremes, Available water supply.

This report summarizes the available data on the water resources of the Central New York Region which includes Cayuga, Cortland, Madison, Onondaga, and Oswego Counties--an area of 3,622 square miles centering around Syracuse. The 740,000 people living in the region use about 310 mgd (million gallons per day) of water for domestic and industrial purposes. About 90% of this water presently comes from surface-water sources. The region includes parts of four major drainage basins: the Mohawk River, the Oswego River, the Susquehanna River, and the Lake Ontario plains. Streamflow in the region is highly variable both from time to time, and from place to place. Groundwater in the region occurs in both consolidated deposits (bedrock) and unconsolidated deposits (sand, gravel, etc.). The bedrock can be divided into seven units on the basis of similarity of lithology and hydrologic porperties. These units are, in ascending order, lower shale, sandstone, sandstone-shale, dolomite, middle shale, limestone, and upper shale. The best sources of groundwater in the region are the unconsolidated deposits of sand and gravel in the major valleys. Maps, graphs, and tables pertinent to the study are included. (Woodard-USGS)
W71-00894

RIVER TIME-OF-TRAVEL AS DETERMINED BY FLUORESCENT DYE MEASUREMENTS AND KINEMATIC WAVE PROCEDURES,
Wyoming Univ., Laramie. Dept. of Engineering.
Gerald R. Zimmerman.
M.S. Thesis, Wyoming University Graduate School, August 1970. 104 p, 43 fig, 9 tab, 31 ref, append. OWRR Project A-001-WYO (31).

Descriptors: *Streamflow, *Flow rates, *Time, *Dye releases, Tracers, Fluorescence, Channel morphology, Discharge measurements, Low flow, Ice, Maps, Wyoming.
Identifiers: *Time-of-travel, *Laramie River (Wyo), High flow, Ice conditions, Curves.

Three time-of-travel measurements using a fluorescent dye as a tracer were conducted on a 108-mile reach of the Laramie River in the vicinity of Laramie, Wyoming, and one measurement on a 5.5-mile reach of Nash Fork in the Snowy Range Mountains. For the Laramie River the studies were during relatively high flow, low flow, and ice conditions. One of the unique portions of the study was that it was conducted under ice conditions. A search of the lieterature failed to find a previous study of travel time with ice cover. Because of the added friction at the surface, the time-of-travel under ice was longer than for open water even for a larger discharge. It was determined that the peak travel time could be reproduced by an overlapped dye cloud while the centroid travel times were not consistant. Because of this, the peak travel times were used to define the mean velocity of the river in a test reach. The results from the time-of-travel studies were compared with mathematically routed dye clouds using the continuity and momentum equations. These comparisons were in good agreement. (Woodard-USGS)
W71-00904

AN APPROACH TO THE SELECTION OF A STREAMFLOW BASE PERIOD,
Wyoming Univ., Laramie. Dept. of Civil Engineering.
For primary bibliographic entry see Field 07C.
W71-00905

WATER RESOURCES OF THE CHAMPLAIN-UPPER HUDSON BASINS IN NEW YORK STATE,
Geological Survey, Albany, N.Y.
G. L. Giese, and W. A. Hobbs, Jr.
New York State Water Resources Commission and Office of Planning Coordination Report, 1970. 153 p, 31 fig, 2 plate, 6 tab, 23 ref, 8 append.

Descriptors: *Water resources, New York, Surface waters, Groundwater, Water quality, Water resources development, Hudson River, Streamflow, Aquifers, Water yield, Water supply, Runoff, Hydrogeology, Data collections, Hydrologic data, Water wells.
Identifiers: Lake Champlain (NY), Hudson River basin (NY).

This report describes the surface- and groundwater resources of the Lake Champlain-Upper Hudson region--a 6,108-square mile area in northeastern New York State. The region is water rich, having an average yearly precipitation of 38 inches. Major rivers include the Saranac, Ausable, Bouquet, Schroon, Sacandaga, and Hudson Rivers. Runoff in streams averages about 1.8 cubic feet per second per square mile but ranges from less than 1.0 to more than 2.0. The valley-fill deposit of the Glens Falls area is the largest groundwater aquifer in the study area. Yields from individual wells in this area average 67 gpm but are as much as 400 gpm from properly constructed wells. The bedrock is most productive where it constitutes an artesian system in the Plattsburgh area. Wells in this system yield an average of 35 gpm and may yield as much as 200 gpm. The chemical quality of the waters is good to excellent. Dissolved solids content, even of the groundwaters, rarely exceeds 500 ppm. In large sections of the Adirondack Mountains underlain by crystalline rocks, dissolved solids content of the groundwaters is less than 100 ppm. The amount of dissolved material in surface waters is even less. High hardness and alkalinity are sometimes found in eastern and northern parts of the area. (Knapp-USGS)
W71-00906

MEANDER GEOMETRY ARISING FROM VARYING FLOWS,
Hydraulics Research Station, Wallingford (England).
For primary bibliographic entry see Field 02J.
W71-01061

THE PROGRESS OF HYDROLOGY: VOL 1--NEW DEVELOPMENTS IN HYDROLOGY.
Illinois Univ., Urbana.
For primary bibliographic entry see Field 02A.
W71-01067

FITZGERALD V FORTIER (LIABILITY FOR OBSTRUCTION OF WATERCOURSES).

198 NE 167-170 (Mass 1935).

Descriptors: *Massachusetts, *Watercourses (Legal), *Obstruction to flow, *Surface drainage, Surface runoff, Culverts, Legal aspects, Judicial decisions, Drainage, Natural flow, Diversion, Channels, Meanders, Beds, Banks, Lakes, Springs, Landfills, Damages.

Plaintiff brought suit against defendant for injunctive relief and damages for defendant's obstruction of a natural watercourse which caused the backing up of water onto plaintiff's land. Plaintiff contended that defendant had filled in his land so that the natural flow of the alleged watercourse was blocked. The prime question was whether the stream of water diverted by defendant onto plaintiff's land was from a natural watercourse or merely surface drainage which ran from defendant's land over the land of plaintiff. The trial court ruled for plaintiff, and the Supreme Judicial Court of Massachusetts affirmed. The court held that the evidence supported the trial court's finding that there was a natural watercourse. Such evidence showed the existence of a natural channel with beds and banks, even though water did not flow on a continual basis. (Duss-Florida)
W71-01082

RECENT DEVELOPMENTS IN MEASURING TECHNIQUES FOR FLOW IN OPEN CHANNELS,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 07B.
W71-01085

STATISTICAL SUMMARIES OF MICHIGAN STREAMFLOW DATA,
Geological Survey, Lansing, Mich.
R. L. Knutilla.
Geological Survey Open-file report, June 1970. 283 p, 5 fig, 15 ref.

Descriptors: *Streamflow, Michigan, *Hydrologic data, Data collections, Duration curves, Low flow, Peak discharge, Statistics, Hydrographs, Streamflow forecasting.
Identifiers: Streamflow data (Mich.).

Michigan gaging station data of 10 or more years of record and which were not seriously affected by regulation are tabulated. Selected summaries--summaries used most frequently by consultants and water managers--are compiled for this report. For each gaging station the following data are provided: duration table of daily discharge; lowest mean discharge; highest mean discharge; monthly mean discharges; annual mean discharge; and annual peak discharges. For stations having 19 or more years of record duration hydrographs are shown. (Knapp-USGS)
W71-01088

CAUSES OF LONG-PERIOD STREAMFLOW FLUCTUATIONS,
For primary bibliographic entry see Field 02A.
W71-01091

APPROXIMATE ESTIMATE OF THE POSSIBLE UTILIZATION OF THE WATER RESOURCES OF KAZAKHSTAN,
For primary bibliographic entry see Field 02A.
W71-01092

A HYDROLOGIC INVENTORY SYSTEM,
State Univ. of New York, Binghamton. Dept. of Geology.
For primary bibliographic entry see Field 07A.
W71-01097

2F. Groundwater

LAND SUBSIDENCE RELATED TO DECLINE OF ARTESIAN HEAD AT BATON ROUGE, LOWER MISSISSIPPI VALLEY, U. S. A.,
Geological Survey, Washington, D. C.
G. H. Davis, and J. R. Rollo.
French resume. In: Land Subsidence, Proceedings Tokyo Symposium - International Association of Scientific Hydrology and UNESCO, September 1969, Vol 1 of 2 Vol, p 174-184, 1970. 11 p, 8 fig, 15 ref.

Descriptors: *Subsidence, *Withdrawal, *Artesian wells, *Louisiana, *Mississippi River Basin, Water levels, Water level fluctuations, Potentiometric level, Confined water, Water utilization, Discharge (Water).
Identifiers: Baton Rouge (La).

Comparison of precise levelling in the Baton Rouge area of the Lower Mississippi Valley indicates as much as 30 cm of subsidence of the land surface during the period 1900-1965. Maximum subsidence is centered in the Baton Rouge industrial district, the area of greatest withdrawals from wells and maximum decline of artesian head. Lines of equal subsidence for the period 1934 to 1965 show a bowl-shaped depression slightly elongated east-west; the 5-cm subsidence line encloses an area of about 250 sq mi. The areal distribution of subsidence corresponds closely with distribution of decline in head in the confined aquifer system. Increases in rate of head decline in heavily pumped zones are reflected in accelerating subsidence. Presumably head decline in the multiple aquifer system of the Baton Rouge area has caused compaction of fine-grained sediments interbedded with and separating the beds of water-bearing sand. Average head decline in the aquifer system in the area of maximum subsidence approximates 200 feet since pumping of confined water began about 1890. The ratio of subsidence to head decline is about 0.5 foot of subsidence for each 100 feet of head decline. Subsidence can be expected to continue with continuing head decline. (Knapp-USGS)
W71-00563

QUANTITATIVE MAPPING OF SALINITY, VOLUME, AND YIELD OF SALINE AQUIFERS USING BOREHOLE GEOPHYSICAL LOGS,
Geological Survey, St. Louis, Mo.; and Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 07C.
W71-00571

NONUNIQUENESS OF STEADY STATE FINGERING SOLUTIONS IN POROUS MEDIA,
Purdue Univ., Lafayette, Ind.
James E. Varnon, and Robert A. Greenkorn.
Water Resources Research, Vol 6, No 5, p 1411-1414, October 1970. 4 p, 8 ref. ACS-PRF Grant 1797-A2, A6.

Descriptors: *Mathematical studies, *Flow, *Porous media, *Interfaces, Oil-water interfaces, Surfaces, Equations, Boundary processes.
Identifiers: Multiphase flow, Fingering.

Steady state solutions for single viscous fingers in 2-phase flow in porous media are nonunique because the position of the interfacial boundary is not specified. Expanding the steady state problem to include an arbitrary number of fingers does not make the solution unique. The initial value problem however does have a unique solution. This suggests that it is futile to look for additional conservation equations in the hope of making the steady state solutions unique. (Knapp-USGS)
W71-00580

FLUID TRAVEL TIME BETWEEN A RECHARGING AND DISCHARGING WELL PAIR IN AN AQUIFER HAVING A UNIFORM REGIONAL FLOW FIELD,
Geological Survey, Denver, Colo. Water Resources Div.
D. B. Grove, W. A. Beetem, and F. B. Sower.
Water Resources Research, Vol 6, No 5, p 1404-1410, October 1970. 7 p, 5 fig, 1 ref.

Descriptors: *Groundwater movement, *Confined water, *Velocity, *Equations, *Computer programs, Mathematical studies, Aquifers, Artesian wells, Injection wells, Tracers, Path of pollutants, Recharge, Discharge (Water), Flow, Steady flow.
Identifiers: Travel time.

Equations describing steady state flow between a recharging-discharging pair of wells in a confined aquifer which has a uniform regional flow field are used in a computer solution for the travel time of fluid between the wells. The time required for a contaminant or a tracer to travel from the recharging well to the discharging well, and the temporal variation in concentration of the contaminant can be read directly from generalized plots of the computer solution. (Knapp-USGS)
W71-00581

VARIATIONAL PRINCIPLES FOR CONFINED AND UNCONFINED FLOW OF GROUNDWATER,
California Univ., Berkeley.
Shlomo P. Neuman, and Paul A. Witherspoon.
Water Resources Research, Vol 6, No 5, p 1376-1382, October 1970. 7 p, 4 fig, 21 ref.

Descriptors: *Groundwater movement, *Flow, *Confined water, *Percolating water, *Mathematical studies, Computers, Computer programs, Dispersion, Diffusion, Saturated flow, Unsaturated flow, Velocity, Darcys law, Capillary action, Steady flow, Unsteady flow.
Identifiers: Finite element techniques, Variational techniques.

Finite element techniques are being employed to an increasing degree in solving complicated groundwater flow problems, including problems with a free surface. These methods usually rely on the development of appropriate variational principles. This paper presents several such principles for both confined and unconfined flow. (Knapp-USGS)
W71-00583

A NEW CONDUCTIVITY METHOD FOR DETERMINING CONCENTRATIONS IN PARALLEL PLATE MODELS,
Guelph Univ. (Ontario).
For primary bibliographic entry see Field 07B.
W71-00593

THE EFFECT OF CONTACT POINTS ON SPECIFIC RETENTION OF RUBBLY ROCK PARTICLES,
Khartoum Univ. (Sudan). Dept. of Geology.
Ismail M. El Boushi.
Journal of Hydrology, Vol 11, No 2, p 159-168, August 1970. 10 p, 3 fig, 3 tab, 6 ref.

Descriptors: *Specific retention, *Capillary water, Hydraulic models, Laboratory tests, Porosity, Porous media, Groundwater, Soil water, Permeability, Specific yield, Water storage, Particle size, Gravels.
Identifiers: Water retention (Porous media).

Most of the water of retention of rubbly rock particles is held by contact points in the form of funicular or pendular water bodies. The contact of 38 mm spheres marks the point where the tendency to form funicular water bodies ends and the tendency to form pendular rings starts. Although the particle surface area for sizes below 38 mm is an important factor in controlling water of retention, water held at the contact points is of more importance. (Knapp-USGS)
W71-00594

FACTORS CONTROLLING THE LOCATION OF THE GROUNDWATER DIVIDE IN NORTHERN ISRAEL,
Israel Geological Survey, Jerusalem.
U. Kafri.
Journal of Hydrology, Vol 11, No 1, p 22-29, July 1970. 8 p, 4 fig, 1 tab, 18 ref.

Descriptors: *Groundwater movement, *Groundwater basins, *Hydrogeology, *Carbonate rocks, Recharge, Discharge (Water), Water levels, Water level fluctuations, Geohydrologic units, Water yield, Water resources development.
Identifiers: Israel.

The location and formation of the regional groundwater divide in the Cenomanian-Turonian carbonate aquifer of Galilee, which today is situated west of the structural axial region, is controlled by two factors: 1, the shifting of the ancient groundwater divide from the structural axis zone westward, due to tectonic movements and formation of new base levels since the Neogene; 2, facies changes within the carbonate aquifer and differences in permeability between its lower and upper subaquifers. As a result, an upconing of the water table may occur during the process of natural recharge, and thus, regional or local groundwater divides may be formed. (Knapp-USGS)
W71-00599

GROUNDWATER ATLAS OF NEBRASKA (REPRINTED JUNE 1969).
Nebraska Univ., Lincoln. Conservation and Survey Div.
For primary bibliographic entry see Field 07C.
W71-00613

BIOLOGICAL ZONATION RELATED TO GROUNDWATER DISCHARGE ALONG THE SHORE OF BISCAYNE BAY, MIAMI, FLORIDA,
Geological Survey, Miami, Fla. Water Resources Div.
For primary bibliographic entry see Field 02L.
W71-00615

GEOLOGY AND GROUNDWATER RESOURCES OF NEW HANOVER COUNTY, NORTH CAROLINA,
Geological Survey, Raleigh, N.C.
George L. Bain.
North Carolina Division of Groundwater Bulletin No 17, April 1970. 79 p, 22 fig, 5 tab, 21 ref.

Descriptors: *Hydrogeology, *Aquifers, *Water resources development, *North Carolina, Groundwater, Water resources, Water quality, Water wells, Artesian wells, Water yield, Transmissivity, Withdrawal, Water supply, Water levels, Data collections, Hydrologic data.
Identifiers: New Hanover County (NC).

This report describes the groundwater resources of New Hanover County in southeastern North Carolina. The county is a part of the Atlantic Coastal Plain Province and occupies a peninsula between the Atlantic Ocean and the Cape Fear and Northeast Cape Fear Rivers. The climate is humid; the average annual precipitation is about 50 inches. Groundwater occurs in a system of slightly inclined formations underlying the Coastal Plain. Maximum thickness in New Hanover County is slightly more than 1,500 feet. Most of the formations are composed of unconsolidated sands and clays containing a few beds of limestone and calcareous sandstone. The volume of water stored in the Coastal Plain formations in New Hanover County is large; however, water in all but the shallow formations is too salty for most uses. Water of acceptable chemical quality for most purposes is available throughout the county, but a wide range in quality of water within the aquifers is common. The current withdrawal of groundwater is only a small part of the available supply. (Knapp-USGS)
W71-00635

TRITIUM - A HYDROLOGIC TOOL,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 07B.
W71-00690

HYDROLOGY OF PROJECT GASBUGGY SITE, RIO ARRIBA COUNTY, NEW MEXICO,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 04B.
W71-00810

FRESHWATER BUBBLES: A POSSIBILITY FOR USING SALINE AQUIFERS TO STORE WATER,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 04B.
W71-00836

FLUID MODEL STUDIES OF THE STORAGE OF FRESHWATER IN SALINE AQUIFERS,
Louisiana State Univ., Baton Rouge.
For primary bibliographic entry see Field 04B.
W71-00838

STORAGE OF NATURAL GAS IN SALINE AQUIFERS,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 04B.
W71-00839

REDUCING LAND SUBSIDENCE IN THE WILMINGTON OIL FIELD BY USE OF SALINE WATERS,
Long Beach Dept. of Oil Properties, Calif.
For primary bibliographic entry see Field 04B.
W71-00840

REPORT ON GEOPHYSICAL AND TELEVISION EXPLORATIONS IN CITY OF JACKSONVILLE WATER WELLS,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 04B.
W71-00849

COMPREHENSIVE PLANNING STUDY OF THE GRAND RIVER BASIN, MICHIGAN--APPENDIX E.
Geological Survey, Lansing, Mich.

Study made with funds administered by US Army Corps of Engineers. Geological Survey Open-file Report, 1970. 76 p, 22 fig, 6 tab, 37 ref.

Descriptors: *Water resources, Michigan, *Groundwater, *Aquifers, Water resources development, Hydrologic data, Data collections, Hydrogeology, Water quality, Water yield.
Identifiers: Grand River basin (Mich).

The principal aquifers in the Grand River basin, Michigan include beds of sand and gravel of glacial origin and bedrock formations of sandstone and limestone. As these aquifers vary considerably in permeability from one area to another, maximum well yields range from less than 10 gpm to more than 1000 gpm. Large yields generally can be obtained from wells adjacent to streams where the aquifers are recharged by the streams. Most of the water obtained from wells is hard to very hard, and much of it contains objectionable concentrations of iron. Most water can be made satisfactory for nearly all uses with commonly-used water treatment processes and equipment. Saline water is present at depth throughout the basin, and in some localities, saline water is at relatively shallow depth. The groundwater reservoirs, although extensively utilized at the present, have considerable potential for additional development. (Knapp-USGS)
W71-00851

THROUGHFLOW ON HILLSLOPES AND ITS RELATION TO THE STREAM HYDROGRAPH,
Bristol Univ. (England).
For primary bibliographic entry see Field 02G.
W71-00858

USE OF SEISMIC REFRACTION MEASUREMENTS FOR GROUND WATER PROSPECTING,
Research Inst. for Water Resources Development, Budapest (Hungary).
J. Galfi, and M. Palos.
Bulletin International Association of Scientific Hydrology, Vol 15, No 3, p 41-46, September 1970. 6 p, 6 fig.

Descriptors: *Groundwater, *Water table, *Seismic studies, *Exploration, Locating, Seismographs, Instrumentation, Sounding, SUBSURFACE INVESTIGATIONS, Sands, Aquifers.
Identifiers: Groundwater prospecting.

In sandy areas the groundwater level can be revealed by seismic refraction measurements. In arenaceous grounds the groundwater level shows a characteristic sudden velocity increase; the groundwater table is in general a refracting boundary. The propagation velocity of compressional seismic waves in the dry sands overlying the groundwater level is 200-350 m/s in general, while in the saturated, wet sands the characteristic value is 1200-1500 m/s. At the groundwater level the acoustic inpedance shows a significant jump, which is partly due to the increase in velocity, and partly to the difference in density. The high increase in impedance accounts for the observed very low energy of waves refracted on the groundwater table. (Knapp-USGS)
W71-00860

THE POISEUILLE ANALOGUE FOR FLOW OF WATER IN WYOMING BENTONITE,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Soils.
A. V. Blackmore.
Journal of Hydrology, Vol 11, No 1, p 59-68, July 1970. 10 p, 2 fig, 1 tab, 22 ref.

Descriptors: *Groundwater movement, *Bentonite, *Hydraulic gradient, Darcys law, Hydrostatic pressure, Porosity, Ion transport, Clays, Porous media, Ion exchange, Membrane processes, Viscosity, Osmosis.
Identifiers: Poiseuille flow.

Water movement, parallel to the plane of orientation, is measured in a Wyoming bentonite as a function of hydrostatic pressure gradient and interparticle spacing; a simple system and technique are used so that some of the difficulties normally associated with the movement of water through reactive materials are avoided. The data are interpreted with the object of establishing a mathematical model based on the slit analogue of the Poiseuille equation, modified for electro-osmosis and anomalous viscosity, as suggested by Kemper. Pore velocity, at constant spacing, is very nearly proportional to pressure gradient (Darcy's law) while at constant pressure gradient it is linearly related to the square of the spacing. When the implications of these results are applied to the analogue an expression is obtained that describes the flow in a satisfactory manner. This expression is compared with one developed for flow in inert materials both within and beyond the limits of the present experiment. (Knapp-USGS)
W71-00863

EVAPORATION OF GROUNDWATER FROM COASTAL PLAYAS (SABKHAH) IN THE ARABIAN GULF,
Raikes and Partners, Rome (Italy).
For primary bibliographic entry see Field 02D.
W71-00865

WATER RESOURCES OF THE CENTRAL NEW YORK REGION,
Geological Survey, Albany, N.Y.
For primary bibliographic entry see Field 02E.
W71-00894

GEOLOGY AND GROUNDWATER RESOURCES OF THE ASHEVILLE AREA, NORTH CAROLINA,
Geological Survey, Raleigh, N.C.
Henry Trapp, Jr.
North Carolina Department of Water Resources Ground Water Bulletin No 16, April 1970. 127 p, 14 fig, 28 tab, 29 ref.

Descriptors: *Hydrogeology, *Groundwater, *Aquifers, North Carolina, Water wells, Water supply, Water quality, Water yield, Geology, Water levels, Data collections, Hydrologic data.
Identifiers: Asheville (NC), Madison County (NC), Buncombe County (NC), Henderson County (NC), Transylvania County (NC).

The Asheville area, comprising Madison, Buncombe, Henderson, and Transylvania Counties, covers 1,860 square miles entirely within the Blue Ridge province in western North Carolina. Springs are the most important source of water in northwestern Madison County for homes, small communities, schools, and other institutions. Dug wells are of some importance as a source of groundwater, whereas bored wells are comparatively rare. The average drilled well in the area is 120 feet deep and has a reported yield of about 15 gallons per minute. Generally, the groundwater is slightly acid, contains less than 100 ppm dissolved solids, and is soft. Dug wells are considerably more susceptible to contamination than springs or drilled wells. Groundwater types can be mapped but are shown to extend across, and change within, boundaries of rock units. Thermal springs occur at Hot Springs in Madison County. The thermal water has a calcium sulfate composition, more than three times the dissolved solids of other groundwater in the Asheville area, and temperatures greater than 100 deg F. (Knapp-USGS)
W71-00903

WATER RESOURCES OF THE CHAMPLAIN-UPPER HUDSON BASINS IN NEW YORK STATE,
Geological Survey, Albany, N.Y.
For primary bibliographic entry see Field 02E.
W71-00906

RECHARGING THE OGALLALA FORMATION USING SHALLOW HOLES,
Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 04B.
W71-01058

TAUNTON RIVER BASIN-MASSACHUSETTS BASIC-DATA REPORT NO. 12, GROUNDWATER SERIES,
Geological Survey, Boston, Mass.
For primary bibliographic entry see Field 04B.
W71-01089

MULTIVARIATE ANALYSIS IN GROUNDWATER HYDROLOGY -- THEORY,
California State Coll., Long Beach. Dept. of Civil Engineering.
A. Eshett.
Water Resources Bulletin, Vol 6, No 5, p 821-825, September-October 1970. 5 p.

Descriptors: *Mathematical models, *Groundwater movement, *Recharge, *Aquifers, Water resources development, Data processing, Statistical models, Statistical methods, Hydrogeology, Correlation analysis, Systems analysis, Linear programming.
Identifiers: Multivariate analysis.

A practical model was developed for the unique determination of the recharge into an aquifer system. The analysis is used to estimate the coefficients of the linear relationship which represent the effective contributions into a groundwater system. The model may be used for the analysis of historic and observed data. The estimates of the procedure are unbiased and consistent, and the statistical model has a good asymptotic efficiency. The application of the statistical analysis to a field situation can be readily carried out. The determination of the effective recharge for distinct hydrologic elements should enable the hydrologist to compute the aquifer response and match it with corresponding historic data. (Knapp-USGS)
W71-01098

2G. Water in Soils

EQUATIONS FOR APPROXIMATING VERTICAL NONSTEADY-STATE DRAINAGE OF SOIL COLUMNS,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Ray D. Jackson, and Frank D. Whisler.
Soil Science Society of America Proceedings, Vol 34, No 5, p 715-718, September-October 1970. 4 p, 5 fig, 1 tab, 13 ref.

Descriptors: *Soil water movement, *Drainage, *Unsteady flow, Hydraulic conductivity, Capillary action, Mathematical models, Equations, Simulation analysis, Unsaturated flow.
Identifiers: Soil drainage.

Equations are derived, from a capillary tube model, that predict vertical nonsteady-state drainage from soil columns over the entire time of drainage for which experimental data are available. The model assumes that a soil column is a bundle of capillaries of various radii with the effective conductivity of the column decreasing as drainage progresses. The conductivity is first considered to be a linear function of the average water level in the column, and then considered to be a quadratic function of the water level. Both resulting equations predict drainage reasonably well when particular values are assigned to the ratio of the average height of capillary rise to the column length. A simplified expression is obtained by neglecting an insignificant term and assigning values to constants in the equation in which the conductivity was taken as a quadratic function of the average water level. The equations are compared with experimental data. (Knapp-USGS)
W71-00552

SOLUBILITY AND HYDROLYSIS OF ALUMINUM IN SOIL SOLUTIONS AND SATURATED-PASTE EXTRACTS,
Auburn Univ., Ala. Dept. of Agronomy and Soils.
For primary bibliographic entry see Field 02K.
W71-00553

EFFECTS OF STEMFLOW WATER ON A MIAMI SOIL UNDER A BEECH TREE: I. MORPHOLOGICAL AND PHYSICAL PROPERTIES,
Ohio Agricultural Research and Development Center, Wooster.
P. L. Gersper, and N. Holowaychuk.
Soil Science Society of America Proceedings, Vol 34, No 5, p 779-786, September-October 1970. 8 p, 8 fig, 3 tab, 16 ref.

Descriptors: *Stemflow, *Soil-water-plant relationships, *Soil formation, *Soil horizons, Soil chemistry, Soil texture, Soil water movement, WATER CHEMISTRY.
Identifiers: Beech trees.

The effects of the stemflow portion of the biohydrologic soil-forming factor on the physical properties of a Miami soil under a beech tree were determined by comparing properties of soil profiles located at different distances from the tree stem. The most obvious effects of stemflow water are a thickening of the A2 horizon, considerable low-chroma mottling in the B horizon, and an increase in the number of subdivisions of the B horizon. Bulk density of the A1 horizon was lowered considerably. Clay content of the A horizon was increased while the content of the B2 horizon was decreased. Correspondingly, the silt content of the A horizon was decreased while the content of the B2 horizon was increased. (Knapp-USGS)
W71-00554

EFFECTS OF STEMFLOW WATER ON A MIAMI SOIL UNDER A BEECH TREE: II. CHEMICAL PROPERTIES,
Ohio Agricultural Research and Development Center, Wooster.
P. L. Gersper, and N. Holowaychuk.
Soil Science Society of America Proceedings, Vol 34, No 5, p 786-794, September-October 1970. 9 p, 11 fig, 3 tab, 30 ref.

Descriptors: *Stemflow, *Soil-water-plant relationships, *Soil chemical properties, Soil formation, Soil physical properties, Soil structure, Soil horizons, Soil chemistry, Soil texture, Soil water movement, Water chemistry.
Identifiers: Beech trees.

The stemflow component of the biohydrologic soil-forming factor caused a much wetter environment, of highly enriched water, in a Miami soil contiguous to a beech tree stem than that prevailing in this soil farther from the stem. This markedly affected the soil such that in A horizons there were progressive increased inward toward the stem in organic C, total N, exch. acidity, exch. K, CEC, and free Fe2 03; and progressive inward decreases in pH, exch. Ca, exch. Mg, and base saturation. In B horizons there were progressive inward decreases in pH, exch. Ca, exch. Mg, exch. K, CEC, base saturation, and free Fe2 03. (Knapp-USGS)
W71-00555

DETACHMENT OF SOIL AGGREGATES BY SIMULATED RAINFALL,
Nebraska Univ., Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 02J.
W71-00556

FIELD MEASUREMENT OF SOIL WATER DIFFUSIVITY,
Wisconsin Univ., Madison. Dept. of Soil Science.
W. R. Gardner.
Soil Science Society of America Proceedings, Vol 34, No 5, p 832-833, September-October 1970. 2 p, 3 ref.

Descriptors: *Soil water movement, *Diffusivity, Diffusion, Unsaturated flow, Capillary conductivity, Hydraulic conductivity.
Identifiers: Soil water diffusivity.

A method is described for calculating the soil water diffusivity of a field profile during drainage. The time rate of increase of soil suction is shown to be related to the diffusivity in a simple way through an approximate solution of the unsaturated flow equation. (Knapp-USGS)
W71-00557

STEADY INFILTRATION FROM LINE SOURCES AND FURROWS,
Agricultural Research Service, Madison, Wis., and Wisconsin Univ., Madison. Coll. of Agriculture.
P. A. C. Raats.
Soil Science Society of America Proceedings, Vol 34, No 5, p 709-714, September-October 1970. 6 p, 5 fig, 22 ref.

Descriptors: *Furrow irrigation, *Infiltration, *Unsaturated flow, *Leaching, Soil water movement, Irrigation design, Irrigation efficiency, Flow, Irrigation systems, Hydraulic conductivity, Equations, Steady flow, Unsteady flow.
Identifiers: Stream function, Partly saturated flow.

Steady infiltration from an array of equally spaced line sources or furrows at the surface of a semi-infinite soil profile is analyzed, based on the assumption that the hydraulic conductivity is an exponential function of the pressure head. Under this assumption, the matric flux potential and the stream function for plane flows satisfy the same linear partial differential equation. Explicit expressions for the stream function, the flux, the matric flux potential, the pressure head, and the total head are obtained. Some implications with regard to furrow irrigation are discussed. The solution provides a rational basis for the discussion of leaching under furrow irrigation. (Knapp-USGS)
W71-00558

THE EFFECT OF CONTACT POINTS ON SPECIFIC RETENTION OF RUBBLY ROCK PARTICLES,
Khartoum Univ. (Sudan). Dept. of Geology.
For primary bibliographic entry see Field 02F.
W71-00594

SOIL-WATER SAMPLING USING PAN AND DEEP PRESSURE-VACUUM LYSIMETERS,
Pennsylvania State Univ., University Park. Mineral Conservation Section; and Water and Air Resources Commission, Dover, Del.
Richard R. Parizek, and Burke E. Lane.
Journal of Hydrology, Vol 11, No 1, p 1-21, July 1970. 21 p, 8 fig, 1 tab, 14 ref.

Descriptors: *Lysimeters, *Soil water, *Sampling, Monitoring, Irrigation water, Soil water movement, Percolation, Infiltration, Water balance, Pennsylvania, Instrumentation, Leaching, Path of pollutants, Landfills, Water quality.
Identifiers: Suction lysimeters.

Two soil-water sampling devices and success achieved in obtaining soil water on a routine basis at depths of 1 to 36 feet below land surface are described. In one facility, metal pans with copper spounts are driven into the wall of an open trench to intercept gravitational water to a depth of 17 feet. From 4 to 6 inches of water are irrigated adjacent to the trench on a weekly basis. The deep trench lysimeter provides gravitational water samples on a routine basis when waters are artificially applied to the site but failed to yield samples during the growing season in the absence of irrigation under Pennsylvania's climate. A modified version of a commercially available lysimeter can extract soil water under tension from depths in excess of 50 feet. This improved soil-water sampler has been named a pressure-vacuum lysimeter or 'suction lysimeter'. One or more lysimeters may be installed in a 6-inch diameter drill hole. The ceramic tip is embedded in a pulverized silica deposit to insure hydraulic continuity with the soil-water reservoir. When sufficient soil-moisture is available 500 to 970 mls of water may be obtained on a weekly basis. During prolonged dry periods, no samples can be collected when soil water has been depleted around the ceramic point. This may be 4 to 8 weeks after pan lysimeters fail to yield water samples. (Knapp-USGS)
W71-00598

A POLAROGRAPHIC TECHNIQUE FOR THE MEASUREMENT OF DISSOLVED SULPHIDE IN WATERLOGGED SOILS,
University Coll. of South Wales and Monmouthshire, Cardiff. Dept. of Botany.
For primary bibliographic entry see Field 02K.
W71-00616

THE MOISTURE REGIMES OF SOILS DEVELOPED ON KEUPER MARL,
Soil Survey of England and Wales.
A. J. Thomasson, and J. D. Robson.
Journal of Soil Science, Vol 18, No 2, p 329-340, September 1967. 12 p, 4 fig, 5 tab, 20 ref.

Descriptors: *Soil moisture, *Regime, Foreign projects, Moisture content, Soil profiles, Porosity, Precipitation (Atmospheric), Water levels.

Identifiers: Moisture release, Subsoiling effects.

The moisture regimes of several representative profiles of the Worcester series developed on Keuper Marl in England and Wales are described and interpreted using a simple field technique supplemented by determinations of pore space, moisture content, and moisture release characteristics. It is suggested that the textural B horizon of coarse blocky structure is the cause of waterlogging which occurs seasonally in the upper 61 cm of these soils. The C horizon, which has a fine blocky structure and a lower clay content, is more permeable, and determinations of pore space and moisture content showed an appreciable volume of air voids in it when the overlying horizons were fully saturated with water. After subsoiling to a depth of 76 cm at one site, the soil was waterlogged less often and then only for shorter periods than formerly. (Woodard-USGS)
W71-00617

PROPERTIES OF DEEP SANDY SOILS AND THE GROWTH OF LOVEGRASS, ERAGROSTIS CURVULA (SCHRAD.) NEES,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia).
P. Farrington, and N. A. Campbell.
Australian Journal of Soil Research, Vol 8, No 2, p 123-132, July 1970. 1 fig, 5 tab, 24 ref.

Descriptors: *Soil properties, *Grasses, *Plant growth, *Soil-water-plant relationships, *Sands, Soil types, Soil moisture, Soil texture, Semiarid climates, Nutrients, Fertilizers, Water table, Rainfall, Root systems, Crop production, Silts, Clays, Soil mechanics.
Identifiers: *Lovegrass, *Australia, *Depth to water.

Field studies of lovegrass (Eragrostis curvula (Schrad.) Nees) were undertaken in the deep sandy soils of Western Australia in an effort to discover how soil properties affect the annual grass yield. Sites were tested for a water table down to 4.5 m. On those plots which had a water table there was a close relationship between annual yield and the two following properties: depth to the water table and silt and clay content in the 30-60 cm soil layer. This relationship, maintained through the years and over a range of nutrition levels, accounted for 87% of the between-site variation in yield. At sites without a water table there was a high negative correlation (PS0.001) between the survival rate of the grass and the coarse sand content of the soil profile. Soil mechanical composition was the most important determinant of yield. In summary, strong associations between yield, mechanical composition, and depth to water suggested that soil moisture status exerted the greatest control on growth of grass. (Carr-Arizona)
W71-00686

GIANT DESICCATION CRACKS IN CENTRAL SOUTH DAKOTA SOILS,
South Dakota State Univ., Brookings.
E. M. White.
Soil Science, Vol 110, No 1, p 71-73, July 1970. 2 fig, 6 ref.

Descriptors: *Cracks, *Sinks, *South Dakota, *Soil moisture, *Soil environment, Alfalfa, Soil water, Soil-water-plant relationships, Semiarid climates, Soil types, Clays, Silts, Soil surfaces.
Identifiers: *Desiccation cracks, *Prisms.

Sinkholes in central South Dakota occur when 20 to 30 cm wide subsoil desiccation cracks extend upward to the surface. Surface soil collapsing into the cracks forms holes which are 1 to 3 m wide and 1 to 3 m deep. A desiccation and contraction process takes place in the clay and silty soils as small prisms give way to large prisms. In humid areas the subsoil remains moist and in arid areas the subsoil is already dry, so that subsoil cracks seldom occur in these regions. It appears that desiccation cracks are confined to semiarid areas. Since alfalfa has perennial roots that can dry the soil to great depth and since sinkholes are most common in 5 to 10 year old alfalfa fields, indications are that water consumption and evapotranspiration by alfalfa cause subsoil desiccation. (Carr-Arizona)
W71-00696

SOIL MOISTURE EFFECTS ON COMPETITIVE ABILITY OF WEEDS,
Southwestern Great Plains Research Center, Bushland, Tex.
Allen F. Wiese, and C. Wendell Vandiver.
Weed Science, Vol 18, No 4, p 518-519, July 1970. 3 fig, 9 ref.

Descriptors: *Weeds, *Competition, *Plant growth, *Dry farming, *Soil moisture, Soil water, Weed control, Wilting, Corn (Field), Sorghum, Agronomy, Arid lands, Semiarid climates, Irrigation, Drying, Wetting, Grasses, Soil-water-plant relationships.
Identifiers: *Russian thistle, *Irrigated agriculture, Dry matter.

Ten species of plants were grown in competition with each other at wet, medium, and dry soil moisture levels in a greenhouse. Corn (Zea mays L.), barnyardgrass (Echinochloa crusgalli (L.) Beauv.), cocklebur (Xanthium pensylvanicum Wallr.), large crabgrass (Digitaria sanguinalis (L.) Scop.), and sorghum (Sorghum vulgare L., var. RS 626) produced the most dry matter when growing in wet soil. These species showed a great reduction in growth on dry soil. Palmer amaranth (Amaranthus palmeri S. Wats.) grew moderately well on wet and medium soil, but less well on dry soil. Even though kochia (Kochia scoparia (L.) Schrad.), Russian thistle (Salsola kali L., var. tenuifolia Tausch), buffalobur (Solanum rostratum Dunal.), and tumblegrass (Schedonnardus paniculatus (Nutt.) Trel.) produced less dry matter than the other species under wet conditions, their growth was not reduced in dry soil. In fact, kochia and Russian thistle produced their greatest amount of dry matter under dry conditions. These results show that soil moisture conditions greatly affect the competitive ability of the weeds. This should partially explain why kochia, Russian thistle, buffalobur, and tumblegrass are problems in dryland farming in arid and semiarid areas, while barnyardgrass, cocklebur, and large crabgrass are pests on irrigated farms. (Carr-Arizona)
W71-00701

CLAY WATER INTERACTIONS. AN EXPERIMENTAL STUDY OF INTERFACE PHENOMENA,
Royal Inst. of Tech., Stockholm (Sweden). Nuclear Magnetic Resonance Group.
E. Froslind, and A. Jacobsson.
Available from NTIS as AD-710 418, $3.00 in paper copy, $0.95 in microfiche. Final Technical Report, May 1970. 55 p.

Descriptors: *Nuclear magnetic resonance, Montmorillonite, *Montmorillonite, Surface properties, Water, Adsorption, Colloids, Interfaces, Dielectric properties, Crystal structure, Sweden, *Surface chemistry, *Hectorite, Mineral.

The structural properties of water adsorbed on hydrophilic intercrystalline clay mineral surfaces have been investigated by way of NMR and dielectric measuring techniques. It is shown that structural ordering of the adsorbed water layers occurs, that the adsorption takes place independent at the exchange cations present in the intercrystalline spaces and that these ions only modify the structural and relaxation properties of the water. The conventional hypotheses regarding the origin of the hydrophilic clay properties are shown to be untenable.
W71-00803

THROUGHFLOW ON HILLSLOPES AND ITS RELATION TO THE STREAM HYDROGRAPH,
Bristol Univ. (England).
D. R. Weyman.
Bulletin International Association of Scientific Hydrology, Vol 15, No 3, p 25-33, September 1970. 9 p, 3 fig, 11 ref.

Descriptors: *Rainfall-runoff relationships, *Storm runoff, *Surface-groundwater relationships, *Subsurface runoff, *Soil water movement, Hydrograph analysis, Subsurface drainage, Percolating water, Base flow, Hydrographs, Overland flow, Flood forecasting.
Identifiers: Throughflow.

Throughflow was measured from three soil horizons on a 12 deg slope. Storm flow comes from the 10-45 cm horizon and is controlled by the upslope extent of saturated conditions. Base flow comes from the 45-75 cm horizon and is supplied by slow unsaturated flow from the whole soil mass to a small constant zone of saturation. Differences between input and output stream hydrographs over 270 m of channel are attributed to throughflow and correlate well with measured values providing a basis for separating throughflow components from the stream hydrograph. Observed stream flows contain no overland flow or groundwater flow components. The main basin flood peak is not generated within this control section of channel but is produced in the headwater zone by the faster runoff characteristics of the soils in that area and by topographic factors which lead to rapid channel extension. (Knapp-USGS)
W71-00858

RESPONSE UNITS FOR EVALUATING THE HYDROLOGIC PERFORMANCE OF RANGELAND WATERSHEDS,
Agricultural Research Service, Boise, Idaho. Northwest Watershed Research Center.
C. B. England, and G. R. Stephenson.
Journal of Hydrology, Vol 11, No 1, p 89-97, July 1970. 9 p, 1 fig, 2 tab, 14 ref.

Descriptors: *Infiltration, *Rainfall-runoff relationships, *Soil water movement, Soil texture, Simulated rainfall, Rainfall simulators, Mathematical models, Storage capacity, Water storage, Permeability, Grasslands, Soil conservation, Water conservation, Hydrograph analysis, Systems analysis.
Identifiers: Rangelands.

A technique is presented for isolating areas within rangeland watersheds which are homogeneous enough in hydrologic characteristics to permit their use as field experimental units or as computational units in hydrograph synthesis. A study of the interactions among geology, soils, topography, and climate on the 90-square mile Reynolds Creek Experimental Watershed, Idaho, revealed predictable relations among these features and the capacity of a given unit of landscape to retain precipitation. The range site concept incorporates similar considerations and may be used in deriving hydrologic units for synthesizing the hydrology of ungaged areas. (Knapp-USGS)
W71-00866

SOIL WATER MEASUREMENT BY A LOW-RESOLUTION NUCLEAR MAGNETIC RESONANCE TECHNIQUE,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 07B.
W71-00870

RELATION OF SOIL HYDRAULIC CONDUCTIVITY TO EXCHANGEABLE CATIONS AND SALINITY,
New Mexico State Univ., University Park. Dept. of Agronomy.
Hessam Mojallali, and H. E. Dregne.
New Mexico State University Agricultural Experiment Station Bulletin 540, November 1968. 11 p, 3 fig, 2 tab, 16 ref.

Descriptors: *Hydraulic conductivity, *Soil water movement, *Ion exchange, *Adsorption, *Soil

chemistry, Soil chemical properties, Soil physical properties, Chlorides, Sodium, Potassium, Ammonia, Calcium, Magnesium, Leaching.
Identifiers: Soil salinity effects.

Leaching experiments on a calcareous Berino sandy loam subsoil showed that soils saturated with exchangeable sodium, potassium, and ammonium became completely impermeable when leached with distilled water. Hydraulic conductivity decreased slightly on soils leached with distilled water after saturation with exchangeable calcium and magnesium. Continued leaching over a six-week period with 5-percent solutions of chloride salts produced a gradual decrease in soil conductivity with sodium and magnesium, but no change with potassium and calcium. Resin column hydraulic conductivity varied with the type of chloride salt used even when the electrical conductivity of the chloride solutions was the same. Hydraulic conductivity decreased in the order of potassium, sodium, calcium, and magnesium, just as in the high salt soil column treatments. Soil hydraulic conductivity is a function of both the elctrical conductivity and the kind of cation of the leaching water. (Knapp-USGS)
W71-00895

A RATIONAL APPROACH TO THE DESIGN OF CHECK SYSTEMS OF IRRIGATION,
Punjab Agricultural Univ., Hissar (India). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W71-00951

RECLAMATION OF A SALINE-ALKALI SOIL IN THE UPPER INDUS BASIN,
For primary bibliographic entry see Field 03F.
W71-00952

THE RELATIONSHIP BETWEEN HEAT TREATMENT AND WATER REPELLENCY IN SOILS,
Forest Service (USDA), Glendora, Calif. Pacific Southwest Forest and Range Experiment Station.
L. F. DeBano.
In: Symposium on Water-Repellent Soils, Proceedings, University of California, Riverside, May 6-10, 1968, Pub March 1969, p 265-279. 4 fig, 2 tab, 4 ref.

Descriptors: *Soil sealants, *Wettability, *Burning, *Chaparral, *Soil water movement, Volatility, Heat treatment, Soil physical properties, On-site investigations, Laboratory tests, Semiarid climates, Convection, Condensation, Soil temperature, Soil texture, Soil investigations, Soil structure, California, Watersheds (Basins).
Identifiers: *Water-repellent soils, Litter, Vaporization.

Samples of water-repellent soils from a burned-over chaparral area were heated in a muffle furnace over temperature ranges of 300-900 degrees fahrenheit (F). Burning times varied in separate samples over 5-20 minutes. From 300-800 F, water-repellency increased with temperature and teatment time, and decreased over 800 F. Calculations of soil temperatures at various depths as a function of surface temperature indicate that the intensification of repellency in situ is unlikely and that volatilization, convection and condensation of hot gases may be occurring. Two subsequent experiments were performed: (1) A 2-inch layer of water-repellent soil was placed over wettable sand and the surface was heated to 1400 F and (2) A 1-1/2 inch layer of undecomposed litter was placed over wettable sand and surface heated until the 3-inch depth reach 200 F. In both cases hydrophobic layers moved down through the soil to deeper depths. These results are similar to recent observations in burned-over areas. Probably the downward movements of volatilized hydrophobic substances are affected by soil texture as well as surface temperature. (Casey-Arizona)
W71-00960

FACTORS RESPONSIBLE FOR WATER REPELLENCE OF SOILS,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia).
R. D. Bond.
In: Symposium on Water-Repellent Soils, Proceedings, University of California, Riverside, May 6-10, 1968, Pub March 1969, p 259-264. 1 fig, 11 ref.

Descriptors: *Soil fungi, *Soil water movement, *Soil sealants, Soil environment, Soil microbiology, Soil moisture, Semiarid climates, Arid lands, On-site investigations, Soil investigations, Shrubs, Acids, Fungi, Infiltration, Sands, Seasonal, Variability.
Identifiers: *Water-repellent soils, *Australia.

Observations made on a variety of Australian soils showed a close correlation between the presence of fungi and soil water repellence. Occurrance of specific fungal species seems to be dependent on specific shrub species. It is felt that such associations may explain variations of water repellency beneath differing plant communities. Extraction of water-repellent soils with nonpolar compounds left repellency unaltered, but extraction with acids considerably reduced it. Seasonal variations in water repellency occur in Mediteranean-type climates in South Australia. The greatest levels existed in the autumn after onset of rains and lowest levels took place in the dry summer. (Casey-Arizona)
W71-00961

SYNTHETIC HYDROPHOBIC SOILS FOR HARVESTING PRECIPITATION,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 03B.
W71-00962

CONTRIBUTION OF SOME SOIL FUNGI TO WATER REPELLENCY IN SOIL MATERIALS,
California Univ., Riverside. Dept. of Soils and Plant Nutrition.
S. M. Savage.
Supported by U.S. Department of Agriculture, Forest Service Grant No. 4000. In: Symposium on Water-Repellent Soils, Proceedings, University of California, Riverside, May 6-10, 1968, Pub March 1969, p 241-257. 5 fig, 3 tab, 16 ref.

Descriptors: *Soil sealants, *Wettability, *Soil physical properties, *Soil fungi, *Soil texture, Soil water movement, Chaparral, Soil temperature, Clays, Sands, Laboratory tests, Soil structure, Soil investigations, Repellents, Fungi, California, Organic matter, Heating.
Identifiers: *Water-repellent soils.

Eight different fungal species were collected and isolated from water-repellent soils of California chaparral areas and injected into sterilized quartz sand with nutrient media. Each culture was incubated for 7, 17, 33 and 53 days. Water repellency appeared, slightly, only in cultures of Penecillium nigricans and Aspergillus sydowi. When the 53-day cultures were heated from 200-400 degrees centigrade, all demonstrated water repellency which decreased with increasing temperature. Solvent extraction indicated that the repellency substances were polar in nature and chemically altered by heating. Cultures of A. sydowi and P. nigricans were initiated in sand-clay mixtures. Results with A. sydowi were: (1) An extremely high repellency occurred in 1 percent clay which decreased with increasing clay percentages and, (2) The sand-clay cultures contained almost twice as much organic matter as the pure sand cultures. By contrast, the wettability of the P. nigricans cultures increased in sand-clay mixtures. The implications of these results are discussed in this paper. It is felt that natural soil-water repellency is probably a product of microbial action. (Casey-Arizona)
W71-00963

THE GRAVIMETRIC METHOD OF SOIL MOISTURE DETERMINATION, PART I - A STUDY OF EQUIPMENT, AND METHODOLOGICAL PROBLEMS,
South Pacific Regional Coll. of Tropical Agriculture, Alafua (Western Samoa).
S. G. Reynolds.
Journal of Hydrology, Vol 11, No 3, p 258-273, September 1970. 16 p, 1 fig, 6 tab, 28 ref.

Descriptors: *Gravimetry, *Soil moisture, *Sampling, *Laboratory tests, Gravimetric analysis, Soil moisture meters, Moisture content, On-site tests, Analytical techniques, Cores, Soil analysis, Test procedures.
Identifiers: Soil moisture analysis.

The type of sampling device, whether a screw or coring auger, is shown to influence soil moisture determinations. Moisture losses after storage of samples in glass tubes or aluminum foil for periods up to 7 days are shown to be negligible. Aluminum foil is recommended as a very inexpensive and efficient container. As the rate and length of drying needed for different soils is quite variable, preliminary investigations should be undertaken to establish the times after which negligible losses occur for further periods of drying. In most field studies samples of 50-100 q of soil are adequate; larger samples of 500 q require much longer periods of drying but give similar results. Methodological problems discussed include the site destruction caused by the gravimetric method and the fact that the method itself accounts for some of the variability found in soil moisture distribution, and possibly for supposedly significant changes in soil moisture content in time and space. (See also W71-01065) (Knapp-USGS)
W71-01064

THE GRAVIMETRIC METHOD OF SOIL MOISTURE DETERMINATION, PART II - TYPICAL REQUIRED SAMPLE SIZES AND METHODS OF REDUCING VARIABILITY,
South Pacific Regional Coll. of Tropical Agriculture, Alafua (Western Samoa).
S. G. Reynolds.
Journal of Hydrology, Vol 11, No 3, p 274-287, September 1970. 14 p, 1 fig, 5 tab, 24 ref.

Descriptors: *Gravimetry, *Sampling, *Soil moisture, Laboratory tests, Gravimetric analysis, Soil moisture meters, Moisture content, Analytical techniques, Cores, Soil analysis, Test procedures.
Identifiers: Soil moisture analysis.

The variability of soil moisture in the 0-8 cm horizon was studied over a range of soil types. Typical sample sizes required to estimate the true mean within variability limits of 10%, 5% and 2% are discussed. The magnitude of variability is shown to vary greatly from area to area, depending in particular upon the stoniness and nature of the soil, and the type and extent of the vegetation cover. Three methods which might reduce sample size are the use of the gravimetric volume basis method instead of the weight basis method, removal of surface vegetation, and removal of stones and rhizomes from samples. (See also W71-01066) (Knapp-USGS)
W71-01065

THE GRAVIMETRIC METHOD OF SOIL MOISTURE DETERMINATION, PART III - AN EXAMINATION OF FACTORS INFLUENCING SOIL MOISTURE VARIABILITY,
South Pacific Regional College of Tropical Agriculture, Alafua (Western Samoa).
S. G. Reynolds.
Journal of Hydrology, Vol 11, No 3, p 288-300, September 1970. 13 p, 4 fig, 4 tab.

Descriptors: *Soil moisture, *Vegetation effects, *Variability, Sampling, Rainfall, Solar radiation, On-site tests, Climates, Seasonal, Heat budget, Evapotranspiration, Moisture content, Retention, Root zone, Slopes, Rainfall, Weather, Soil physical properties.

Identifiers: Soil moisture variability.

The influence of various environmental factors on soil moisture variability in the 0-8 cm horizon is examined. The investigation of the influence of vegetation types revealed at least three tentative variability groups (in order of increasing variability) corresponding to areas of recent cultivation, areas of permanent or ley grass, and predominantly uncultivated moor or heathland areas. The dynamic nature of seasonal variability changes are illustrated and correlations established with the amounts of rainfall and insolation in the week preceding sample collection, and the degree of moisture saturation at the time of sampling. Required sample size was directly related to mean moisture content, or the degree of moisture saturation, and the amount of insolation. It is suggested therefore that a decrease in soil moisture content is associated with a decrease in the variance of sample means, and an increase in moisture content is associated with an increase in variance. (See also W71-01064) (Knapp-USGS)
W71-01066

2H. Lakes

AN APPROACH TO RESERVOIR TEMPERATURE ANALYSIS,
Army Corps of Engineers, Sacramento, Calif., Hydrologic Engineering Center.
Leo R. Beard, and R. G. Willey.
Water Resources Research, Vol 6, No 5, p 1335-1345, October 1970. 11 p, 7 fig, 2 tab, 4 ref.

Descriptors: *Reservoir operation, *Mathematical models, *Water temperature, *Water quality control, *Computer programs, Water management (Applied), Reservoir design, Regulation, Reservoir storage, River forecasting, Data processing, Water quality, Water yield, Water resources development.
Identifiers: Reservoir water temperature predicting.

Several recent mathematical models for analyzing reservoir temperature stratification involve examination of hourly temperature changes. Their use in practical applications is limited by the large amount of data required, and a more general model to calculate reservoir storage for bridging long drought periods requires examination of many combinations of reservoir storage levels and seasonal inflow patterns. Because 30 or more years of data are required, the model is practical only if a long computation interval, such as one month, can be used. A practical management model must use generalized data such as average air temperature and average radiation must be capable of planning releases through specific outlets or automatically selecting the outlets that will maintain outflow temperatures within a desired range as long as possible and the temperature of the remaining stored water should be held at an optimum value. A computer program was developed that conforms to these requirements and automatically calibrates the model. (Knapp-USGS)
W71-00567

VERTICAL TEMPERATURE STRUCTURE AND WATER SURFACE HEAT EXCHANGE,
Pennsylvania Univ., Pa.
John Eric Edinger.
Water Resources Research, Vol 6, No 5, p 1392-1395, October 1970. 4 p, 1 fig, 1 tab, 6 ref.

Descriptors: *Water temperature, *Heat transfer, *Mixing, Meteorology, Lakes, Convection, Mathematical studies, Diffusion, Dispersion, Heat budget, Heat balance, Seasonal, Thermal stratification, Reservoirs.
Identifiers: Temperature structure (Lakes).

A balance is assumed between the time change in heat storage and the net vertical dispersive heat transfer within a water column. The average surface temperature and its amplitude are related to surface heat exchange using the concept of equilibrium temperature. This results in a set of relationships for using meteorological data for estimating the seasonal time-variance of vertical temperature structure of lakes or reservoirs. (Knapp-USGS)
W71-00568

WATER BALANCE OF LAKE CHALA AND ITS RELATION TO GROUNDWATER FROM TRITIUM AND STABLE ISOTOPE DATA,
International Atomic Energy Agency, Vienna (Austria).
Bryan R. Payne.
Journal of Hydrology, Vol 11, No 1, p 47-58, July 1970. 12 p, 3 fig, 2 tab, 12 ref.

Descriptors: *Surface-groundwater relationships, *Lakes, *Tracers, *Water balance, *Tritium, Hydrologic budget, Stable isotopes, Radioisotopes, Tracking techniques, Recharge, Discharge (Water), Groundwater movement, Water chemistry, Water yield, Irrigation water.
Identifiers: Lake Chala (Kenya).

Artificially injected tritium was used to estimate the water balance of Lake Chala, Kenya, which has no surface inflow or outflow. Over 5 years mean annual subsurface inflow and outflow are estimated to be 12.5 million cu m and 8.2 million cu m respectively. Environmental tritium cannot be used for such a balance estimation. The relation of the lake to springs in the area was studied on the basis of the deuterium and oxygen-18 content of the waters. None of the springs derives a major component of its discharge from the lake. Tritium concentrations of two springs point to a high probability of partial recharge by lake water. (Knapp-USGS)
W71-00601

DYNAMIC MODEL STUDY OF LAKE ERIE, PART I. SIMILITUDE CRITERIA AND EXPERIMENTAL SET-UP,
State Univ. of New York, Buffalo. Faculty of Engineering and Applied Sciences.
Ralph R. Rumer, Jr.
Available from NTIS as PB-195 544, $3.00 in paper copy, $0.95 in microfiche. Civil Engineering Report No. 18.1, August, 1970. 43 p, 9 fig, 21 ref. FWQA Program Grant WP-00837.

Descriptors: *Lake Erie, *Model studies, *Hydraulic models, *Simulation analysis, Currents (Water), *Hydraulic similitude, Synthetic hydrology, Water circulation, Movement, Water quality, Water pollution control, Dilution.
Identifiers: Rotating model.

Both analytical and experimental investigations employed to provide basic information concerning water movement in the Lake. The knowledge and experience acquired in the course of this study should improve our capability to construct and operate rotating hydraulic models. This information should also assist in the overall water quality management of the Lake. The studies reported here deal with the idealized conditions of zero wind stress (including the inflow of the Detroit River and the outflow of the Niagara River) and, under this same flow condition, with the superposition of a uniform westerly wind over the surface of the Lake. The water mass is isothermal and variations in density are assumed absent. Under these conditions, investigations of the circulation patterns were conducted. Also studied was the oscillation of the entire water mass in the model lake. In particular, attention was given to the transient effect that this mass oscillation had on the otherwise steady-state circulation pattern and its effect on the mixing and dilution of waste discharges into the lake. The mixing and dilution of tracers introduced at various positions in the model lake were also studied under these same conditions of zero wind stress and constant throughflow and with the superposition of the westerly wind. A highly idealized model of Lake Erie was also constructed and operated. This model was rectangular in shape, of constant depth, and had the same length to width ratio as Lake Erie. Circulation patterns, the decay of sciches, and mixing of tracers were also studied in this idealized model. The results obtained from the idealized rectangular basin helped to delineate the major effects of geometrical variations that were present in the scaled Lake Erie model. This report recounts the development of the laboratory and the model lake and summarizes the analytical and experimental work accomplished thus far. (See also W71-00622).
W71-00621

DYNAMIC MODEL STUDY OF LAKE ERIE, PART II, ANALYTICAL AND EXPERIMENTAL RESULTS,
State Univ. of New York, Buffalo. Faculty of Engineering and Applied Sciences.
Ralph R. Rumer, Jr.
Available from NTIS as PB-195 545, $3.00 in paper copy, $0.95 in microfiche. Civil Engineering Report No 18.2, August, 1970. 39 p, 2 tab, 22 fig, 33 ref. FWQA Program Grant WP-00837.

Descriptors: *Lake Erie, *Model studies, Hydraulic models, *Simulation analysis, Currents (Water), *Hydraulic similitude, Synthetic hydrology, Water circulation, Movement, Water quality, Water pollution control, Dilution.
Identifiers: Rotating model.

This second report considers the experimental results obtained and the relationship of these results to various mathematical model approaches to the hydraulic study of Lake Erie. Based on the experimental and analytical results of this study, the following summarizing statements are made regarding the dynamic behavior of Lake Erie. In the absence of wind, the throughflow caused by the inflow of the Detroit River and the outflow of the Niagara River generates significant currents and easily observable patterns of circulation. The presence of westerly wind significantly alters the circulation patterns of Lake Erie as observed in the absence of wind. A procedure for relating model wind speeds to prototype wind speeds based on similarity between wind set-up in model and prototype has been presented. The period for the first mode mass oscillation in the model lake is in good agreement with calculated and observed periods. Observed detention periods show significant short circuiting for the homogeneous lake with no wind stress. Only limited correspondence can be achieved in modeling dispersion in vertically distorted Froude models of very large bodies of water. (See also W71-0062).
W71-00622

COMPILATION OF DATA FOR MICHIGAN LAKES,
Geological Survey, Lansing, Mich.
J. B. Miller, and T. Thompson.
Geological Survey Open-file Report, June 1970. 368 p, 1 fig, 1 tab.

Descriptors: *Hydrologic data, *Lakes, *Synoptic analysis, Data collections, Gaging stations, Inflow, Lake stages, Hydrographs, Maps.
Identifiers: Lake outflow, Lake drainage area, Basic data.

Lake data collected in Michigan through water year 1968 (September 30, 1968) are presented. Included, for each lake, are a description of the lake, a list of discharge measurements made on the inlet and outlet streams, quality of water data, location maps, and lake-stage hydrographs. Daily readings of lake levels were usually made on the lakes, but in this report only the monthly extremes are shown in the hydrographs. That is, the highest and lowest readings each month are plotted. (Woodard-USGS)
W71-00637

PHOSPHATE REDUCTION IN LAKES BY PRECIPITATION WITH ALUMINIUM SULPHATE,
Swedish Water and Air Pollution Research Laboratory, Stockholm.
A. Jernelov.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 2, 1970. Preprint. 5 p, 4 fig, 1 tab.

Descriptors: *Chemical precipitation, *Phosphates, *Lakes, Aluminum, Sulfates, Eutrophication, Oxygen, Sediments, Algae, Calcium, Chlorophyta, Cyanophyta, Toxicity, Seasonal, Municipal wastes, Depth, Coliforms, Iced lakes, Diatoms, Water management, Water pollution control, Water quality control, Flocculation.
Identifiers: *Phosphate reduction, Stockholm (Sweden), Phragmites, Nymphaea, Grass- and silver-carps, Invertebrates, Mysis relicta, Neuropteran larvae, Cryptophyceae, Lake restoration.

Release of phosphate from anaerobic bottom sediments with and without addition of aluminum and calcium were studied. Aluminum was chosen rather than calcium because it gave better flocculation. Toxicological studies of invertebrates were made to determine effect of aluminum hydroxide formed at precipitation of lake water with aluminum sulphate. Experiments showed the most suitable time for adding aluminum sulphate was when the greatest amount of the 'mobile' phosphorus in the aquatic system was in phosphate form. Swedish shallow lakes should be precipitated in early spring immediately after ice desolution. In deeper lakes, the treatment can be done in spring or autumn, immediately before the circulation. Lake Langsjon--a eutrophic shallow lake near Stockholm--was precipitated in April 1968 with about 50 grams granulated aluminum sulphate/cubic meter of lake volume. Results were: lowered concentration of total phosphorus, somewhat better oxygenation during the 1968-1969 winter, and no release of phosphate from the sediments although conditions were anaerobic. As the trend for the standing crop of planktonic algae in the lake is negative, no certain effect of precipitation on algae numbers can be determined from the precipitation. (Jones-Wisconsin)
W71-00661

PHOTOSYNTHESIS AND ZONATION OF FRESHWATER MACROPHYTES. I. DEPTH DISTRIBUTION AND SHADE TOLERANCE,
Saint Andrews Univ. (Scotland). Dept. of Botany.
For primary bibliographic entry see Field 02K.
W71-00670

THE USE OF THE RADIOCARBON METHOD FOR SUBDIVISION OF PLANKTONIC ANIMALS ACCORDING TO THEIR TROPHIC LEVELS (IN RUSSIAN),
Akademiya Nauk SSSR. Institut Okeanologii; Akademii nauk SSR, Moscow. Institut Biologii Vnutrennjkh Vod.
For primary bibliographic entry see Field 07B.
W71-00671

DISTRIBUTION OF RIVER WATERS IN THE NORTHERN PART OF THE LAKE BAIKAL AS INDICATED BY HYDROCHEMICAL DATA (IN RUSSIAN),
V. T. Bogdanov.
Doklady Academy of Sciences of USSR, Vol 185, No 3, p 649-652, 1969. 1 fig, 2 tab, 4 ref.

Descriptors: *Lakes, *Tributaries, Chemical analysis, Hardness (Water), Oxygenation, Temperature, Winds.
Identifiers: Lake Baikal (USSR), Hydrocarbonates.

Waters of the rivers flowing into the northern part of the Lake Baikal are distinguished from the lake water by the relative contents of several constituents, such as hydrocarbonates, calcium, and silica, as well as the degree of hardness and oxygenation. These features permitted to establish the range of the beneficial influence of northern tributaries on the volume and oxygenation of the lake. The latter process is augmented by winds, especially those of the fall season. (Wilde-Wisconsin)
W71-00676

INTERRELATIONS BETWEEN SULPHUR AND CARBON TURNOVER IN MEROMICTIC LAKES,
Akademiya Nauk SSSR, Mowcow. Institut Biologii Vnutrennykh Vod.
Yu. I. Sorokin.
Archiv fur Hydrobiologie, Vol 66, No 4, p 391-446, 1970. 33 fig, 22 tab, 31 ref.

Descriptors: *Lakes, *Carbon, *Sulfur, Temperature, Oxygen, Phytoplankton, Zooplankton, Bacteria, Turnovers, Sulfur bacteria, Distribution, Laboratory tests, Primary productivity, Photosynthesis, Migration, Chemical properties.
Identifiers: *Sulfur-carbon turnover, Meromictic lakes, Redox potential, Carbon assimilation, Susljaev's sampler, Volga Region (USSR), Vertical distribution.

This voluminous report is primarily concerned with sulphur-cycle organisms of three meromictic lakes of northern Russia. Investigations of lake profiles included temperature, oxygen concentration, redox potential, and transformations of sulphur compounds. The survey recorded the distribution of phytoplankton, zooplankton, and sulphur bacteria. A part of the study was devoted to laboratory observations of the chemical and biological oxidation of sulphides as far as these processes are related to the chemo-autotrophic cycle of the investigated meromictic lakes. The results showed that oxidation of hydrogen sulphide provides an additional source of primary production in the form of bacteria consumed by zooplankton. (Wilde-Wisconsin)
W71-00677

STREAM OF ENERGY IN THE ECOSYSTEM OF AN EUTROPHIC LAKE (IN RUSSIAN),
Akademiya Nauk SSSR. Zoologicheskii Institut.
G. G. Vinberg.
Doklady Academy of Sciences of USSR, Vol 186, No 1, p 198-201, 1969. 1 tab.

Descriptors: *Lakes, *Energy, *Energy equation, Biomass, Phytoplankton, Zooplankton, Benthos, Fish, Nutrients, Primary productivity, Correlation analysis, Mathematical studies, Ecosystems.
Identifiers: Food consumption, Food assimilation, Lake Driviaty (Belorussia).

This ecosystematic survey of the 3000-hectare eutrophic lake included determinations of primary production, phytoplankton, zooplankton, zoobenthos, and population as well as fish nutrition. Each component of the ecosystem was appraised in terms of its biomass (B), production (P), catabolism (T), loss of energy in exchange and assimilation of food (A—T..P), consumption of food (R), and the corresponding rations P/B, T/B, and P/A. For a population having a constant biomass, the coefficient P/B expresses the 'turnover rate,' whereas the value B/P--the 'turnover time.' Both oxygen consumption method and solution of the equation rendered similar T values. The fish consumed during the summer 2.65% of the total supply of energy; the annual harvest of fish constituted only 0.14% of the total primary production. (Wilde-Wisconsin)
W71-00678

TROPHIC NATURE OF SELECTED WISCONSIN LAKES,
Wisconsin Dept. of Natural Resources, Madison. Div. of Environmental Protection.
Lloyd A. Lueschow, James M. Helm, Donald R. Winter, and Gary W. Karl.
Transactions of the Wisconsin Academy of Sciences, Arts and Letters, Vol 48, p 237-264, 1970. 3 fig, 5 tab, 5 ref.

Descriptors: *Wisconsin, *Lakes, *Eutrophication, Oligotrophic, Sampling, Water quality, Phosphorus, Rooted aquatic plants, Chara, Weed control, Size, Depth, Hydrogen ion concentration, Hardness (Water), Alkalinity, Plankton, Nitrogen, Temperature, Dissolved oxygen, Hypolimnion, Light penetration, Zooplankton, Diatoms, Cyanophyta, Copper sulfate, Chlorophyta, Chlorella, Epilimnion.
Identifiers: Inorganic debris, Flagellates, Volatile solids.

Several water quality parameters of 12 Wisconsin lakes were evaluated. Parameters selected included nitrogen and phosphorus, temperature, dissolved oxygen, water transparency, and plankton analysis. The lakes are ranked on annual means of the five parameters. Presence of dissolved oxygen in the hypolimnion during summer stagnation has an important effect on fish, but can be misleading as a trophic index since the volume of the hypolimnion tempers the effect of production and decomposition. Plankton samples collected did not fully measure the standing crop of organic production since rooted or attached growths were ignored, and small algal cells may pass through nets. Diatoms and zooplankton did not develop nuisance conditions in any of the lakes. Monthly analysis for organic nitrogen produced a ranking that was reasonably consistent with transparency, plankton, and recreational potential; analyses for soluble phosphorus had a coefficient of variation approaching 100%, indicating samples were inadequate for reliable confidence interval about a mean; analysis for total phosphorus gave figures suggesting which lakes would be essentially free of aquatic nuisances and which would experience nuisance weed growths or algal blooms during most of the growing season. (Jones-Wisconsin)
W71-00682

PRIMARY PRODUCTIVITY, CHEMO-ORGANOTHROPHY, AND NUTRITIONAL INTERACTIONS OF EPIPHYTIC ALGAE AND BACTERIA ON MACROPHYTES IN THE LITTORAL OF A LAKE,
Michigan State Univ., East Lansing. Dept. of Botany and Plant Pathology.
Harold LeRoy Allen.
Available from NTIS as COO-1599-25 (Pt. 2), $3.00 in paper copy, $0.95 in microfiche. 1969. 186 p. Ph D Thesis.

Descriptors: *Lakes, *Productivity, Michigan, *Epiphytology, Nutrients, Plant pathology, *Algae.
Identifiers: Lawrence Lake (Michigan), *Macrophytes.

Assessment of epiphytic algal and bacterial in situ community metabolism, and physiological-nutritional interrelationships of macrophyte-epiphyte systems, were investigated in the littoral zone of a small temperate lake from April 1968 through May 1969. Annual primary productivity, chemo-organotrophic utilization of dissolved organic compounds, and field and laboratory studies of macrophyte-epiphyte interactions were monitored by carbon-14 techniques. Qualitative and quantitative photosynthetic pigment composition, and a brief taxonomic examination of the sessile complex, accompanied measurement of field parameters. Productivity measurements of epiphytic algae on artificial substrata colonized in emergent (Scirpus acutus Muhl.) and submergent (Najas flexilis L. and Chara spp.) macrophytic vegetation sites were compared over an annual period with pigment (chlorophyll a and total plant carotenoids) estimates of biomass.
W71-00832

A PRELIMINARY INVESTIGATION OF SUSPENDED SEDIMENTS IN KAINJI LAKE, NIGERIA,
Ife Univ. (Nigeria).

For primary bibliographic entry see Field 02J.
W71-00857

CHARACTERISTICS OF THE TEMPERATURE AND VELOCITY REGIME OF BRATSK RESERVOIR UNDER AN ICE COVER,
Central Inst. of Weather Forecasting, Moscow (USSR).
S. N. Bulatov.
Trans. of Trudy Ts1P, No 151, 1966. Soviet Hydrology: Selected Papers No 3, 1966, p 262-276. 4 fig, 5 tab, 4 ref.

Descriptors: *Thermocline, *Heat balance, *Reservoirs, Lakes, Currents (Water), Thermal properties, Cooling water, Temperature, Cooling, Water temperature, Heat flow, Thermal stratification, Temperature gradients, Ice, Ice-water interfaces, Lake ice.

The interrelationship between the vertical water temperature and current velocity distributions under an ice cover in cross sections in various parts of the Bratsk Reservoir are described. The thermocline was found also under ice conditions. The thermocline is usually several meters thick and smoothly merges with the overlying and underlying layers. The heat exchange coefficient varies with depth. No thermocline forms under the ice cover of lakes and reservoirs, in the absence of a current. Also it is not observed in through-flow, but shallow reservoirs. The description of the formation of a thermocline in the reservoir is presented. The theory was developed according to the heat balance . Computations for the reservoir were performed, and a working equation has been proposed. (Novotny-Vanderbilt)
W71-00916

HEAT TRANSFER COEFFICIENT IN WATER BODIES WITH LIMITED FLOWAGE DURING SUMMER HEATING,
State Hydrological Inst., Leningrad (USSR).
K. I. Rossinskiy, and M. P. Kravtsova.
Trans. of Trudy GG1, No 162, 1969. Soviet Hydrology: Selected Paper, No 1, 1969, p 27-38. 2 tab, 5 fig, 5 ref.

Descriptors: *Transfer, Heat, Thermal properties, Lakes, Reservoirs, Reservoir stages, *Thermal stratification, Impounded waters, Heat budget, Thermocline, Gradient, Epilimnion.
Identifiers: Heat transfer coefficients.

In contrast to small turbulent bodies of water, within which the basic heat transfer agent throughout the year is turbulent water flow, in the waters of deep water bodies heat transfer occurs during different seasons and in different parts of the water bodies under the influence of different factors. Accordingly, six periods were defined with different heat transfer patterns in the water layers of deep lakes and reservoirs, and the vertical and horizontal temperature distributions were examined. It was found that the test heat conductivity coefficients were not uniform over the depth and length of reservoirs. For a stationary regime the ratio of the heat conductivity coefficients is inversely proportional to the temperature gradients of the bounding layers. The degree of nonuniformity of heat exchange between a water body and the atmosphere is proportional to its mean intensity. The results and observations of several lakes are presented. (Novotny-Vanderbilt)
W71-00917

DISSOLVED OXYGEN VARIATIONS IN STRATIFIED LAKES,
Oregon State Univ., Corvallis.
David A. Bella.
Journal of the Sanitary Engineering Division, Proceedings of the ASCE, Vol 96, No SA5, Paper 7628, p 1129-1146, Oct 1970. 11 fig, 15 ref.

Descriptors: *Stratification, *Temperature, *Oxygen, Lakes, Dissolved, Mixing, Reaeration, Reservoirs, Algae, Hypolimnion, Mathematical models, Depth, Respiration, Washington.
Identifiers: Vertical dispersion coefficient, Lake Sammamish (Washington).

A mathematical model describing the dissolved oxygen variations in a stratified lake is developed. The model is one dimensional and includes dissolved oxygen variation with depth and time. The model describes the combined effect of reaeration, photosynthetic oxygenation, vertical mixing and oxygen uptake. A method for estimating hypolimnetic oxygen demands in stratified lakes was presented and used for analysis of data from Lake Sammamish, Washington. The possibility that the hypolimnetic DO depletion during summer months in Lake Sammamish was largely due to benthal oxygen demand was investigated and analysed. A series of model computations using finite-difference methods demonstrates that hypolimnetic oxygen levels within stratified lakes were more sensitive to both vertical mixing and hypolimnetic respiration to either photosynethetic oxygenation or reaeration. (Upadhyaya-Vanderbilt)
W71-00978

EFFECTS OF ORGANIC ACIDS ON THE FLOCCULATION OF SUSPENDED SEDIMENTS IN TROPICAL MAN-MADE LAKES,
Ife Univ. (Nigeria).
L. Olayinka Asseez.
Journal of Hydrology, Vol 11, No 3, p 253-257, September 1970. 5 p, 1 fig, 1 tab, 1 ref.

Descriptors: *Organic acids, *Flocculation, *Deposition (Sediments), *Suspended load, *Reservoir silting, Sediment yield, Sedimentation, Dispersion, Sampling, Sediment control.
Identifiers: Kainji Lake (Nigeria).

Thirty-five suspended sediment samples from Kainji Lake, Nigeria were studied to determine the effect of dispersion on the natural particle size distribution in the natural water. The rapid rate of decay of the submerged plants released a copious amount of humic acids which served as strong flocculants, and this has an important effect on the settling rate of suspended sediments, particularly in tropical lakes. This decay was highest in the Foge Island area, which was submerged three days after the gates of the dam had been closed. Considering deposition in stagnant waters, flocculation arising from decaying organic matter may be as important as reduction in velocity. The rate of sedimentation within a reservoir can be estimated from data on volume and thickness of sediments deposited during a given period. If flocculation arising from decay of organic matter is high during the first few years, a later comparable rate of deposition cannot be assumed even when all other conditions remain constant. (Knapp-USGS)
W71-01062

2I. Water in Plants

EFFECTS OF STEMFLOW WATER ON A MIAMI SOIL UNDER A BEECH TREE: I. MORPHOLOGICAL AND PHYSICAL PROPERTIES,
Ohio Agricultural Research and Development Center, Wooster.
For primary bibliographic entry see Field 02G.
W71-00554

EFFECTS OF STEMFLOW WATER ON A MIAMI SOIL UNDER A BEECH TREE: II. CHEMICAL PROPERTIES,
Ohio Agricultural Research and Development Center, Wooster.
For primary bibliographic entry see Field 02G.
W71-00555

LEACHING OF CROP RESIDUES AS A SOURCE OF NUTRIENTS IN SURFACE RUNOFF WATER,
Agricultural Research Service, Morris, Minn.; and Minnesota Univ., Morris.
For primary bibliographic entry see Field 05B.
W71-00584

EXTRACTION TERM MODELS OF SOIL MOISTURE USE BY TRANSPIRING PLANTS,
Stanford Univ., California.
F. J. Molz, and Irwin Remson.
Water Resources Research, Vol 6, No 5, p 1346-1356, October 1970. 11 p, 6 fig, 1 tab, 18 ref.

Descriptors: *Soil-water-plant relationships, *Transpiration, *Soil water movement, *Moisture uptake, *Root systems, Velocity, Unsaturated flow, Mathematical models, Respiration, Translocation, Soil moisture, Flow, Hydraulic conductivity, Moisture content, Moisture availability, Water utilization, Root zone.
Identifiers: Soil water extraction.

A mathematical model is developed describing moisture removal from soil by the roots of transpiring plants. The model uses a macroscopic extraction term in the one-dimensional soil moisture flow equation. It describes both moisture removal by the plant and induced moisture movement through the soil. A numerical procedure based on the Douglas-Jones predictor-corrector method is used to solve the model, and solutions are compared with experimental data. The results indicate that extraction term models are computationally and physically feasible and give insight into the mechanics of the overall moisture extraction process. (Knapp-USGS)
W71-00586

EFFECT OF VARIOUS SALINITY REGIMES ON GROWTH, LEAF EXPANSION AND TRANSPIRATION RATE OF BEAN PLANTS,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcano Institute of Agricultural Research; and Hebrew Univ. of Jerusalem (Israel).
For primary bibliographic entry see Field 03C.
W71-00685

PROPERTIES OF DEEP SANDY SOILS AND THE GROWTH OF LOVEGRASS, ERAGROSTIS CURVULA (SCHRAD.) NEES,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia).
For primary bibliographic entry see Field 02G.
W71-00686

HEAVY PRECIPITATION INFLUENCES SALINE CLAY FLAT VEGETATION,
Texas A and M Univ., College Station. Dept. of Range Science.
P. E. Buckley, and J. D. Dodd.
Journal of Range Management, Vol 22, No 6, p 405-407, June 1969. 2 fig, 2 tab, 8 ref.

Descriptors: *Range grasses, *Arid lands, *Precipitation (Atmospheric), *Vegetation, *Productivity, Texas, Xerophytes, Moisture stress, Biomass, Ranges, Grama grasses, Forage grasses, Clay minerals, Ecology, Hurricanes, Brush, Grasses, Density, Plant populations, Salts.
Identifiers: *Rio Grande Plains (Texas).

The saline, clay soils of the Rio Grande Plains, Texas, are considered drought-prone because of high salt content, low rainfall and high evaporation. Owing to past overgrazing, many grass species have decreased or disappeared and the area has been invaded by xeric shrubs. A vegetational analysis of a study area was performed after it had been closed to grazing for 5 years. Only 4 grass species were identified and their heights were below 2 inches. Plant densities ranged from 2500-66,000 per acre and herbage production was not measurable. Three months later after a hurricane (Beulah) had resulted in a 13 inch rainfall increase, the area was again surveyed. A large influx of annual and short-lived perennial grasses had changed plant composition, densities and yield. Densities ranged from 400,000-1,000,000 plants/acre and mean production ranged from 731.7-1743.7 lbs/acre. Production of these short-lived grasses provided a suitable

microenvironment for establishment of more suitable grasses. (Casey-Arizona)
W71-00687

MICROBIOLOGICAL PROBLEMS IN THE ARID ZONE OF WEST PAKISTAN,
University of the Punjab, Lahore (Pakistan). Dept. of Zoology.
Rafat H. Jafri.
Pakistan Journal of Science, Vol 20, No 5 and 6, p 308-312, September-November 1968. 32 ref.

Descriptors: *Arid lands, *Microbiology, *Nitrogen fixing bacteria, *Decomposing organic matter, Public health, Ammonification, Diseases, Deserts, Winds, Sands, Semiarid climates, Microorganisms.
Identifiers: *Pakistan.

Nearly two-thirds of West Pakistan is arid. High temperatures, strong dessicating winds, flash floods and erratic rainfall are interacting factors contributing to the steady 1 mile per year advancement of the desert. It is estimated that about 200,000,000 acres of land could be brought into cultivation but so far only 45,000,000 acres are being farmed. Much work must be done in this arid zone if progress is to occur. The author feels that microbiological problems unique to the arid zone must be attacked. Areas suggested for study are: (1) Microorganisms involved in crop and timber diseases, (2) The ammonifying microflora of unploughed desert soils, (3) Nitrifying bacteria of the rhizophores of desert plants, (4) The microbial balance of areas soon to be newly irrigated, (5) Microbial decomposition of organic matter for fertilizer, (6) Food decay microorganisms, (7) The use of disease-producing microorganisms to control wild animal populations and (8) Public health. (Casey-Arizona)
W71-00689

INVASION OF MEDUSAHEAD INTO THE GREAT BASIN,
Agricultural Research Service, Reno, Nev. Crops Research Div.; and Nevada Agricultural Experiment Station, Reno.
James A. Young, and Raymond A. Evans.
Weed Science, Vol 18, No 1, p 89-97, January 1970. 3 fig, 6 tab, 37 ref.

Descriptors: *Weeds, *Great Basin, *Soil moisture, *Vegetation establishment, *Environmental effects, Arid lands, Semiarid climates, Oregon, California, Idaho, Nevada, Rainfall, Soil water, Water requirements, Invasion, Biological communities, Ranges, Sagebrush, Soil types, Clays, Weed control, Plant populations.
Identifiers: *Medusahead, *Annual plants, *Vertisols, *Site degradation.

Medusahead (Taeniatherum asperum (Sim.) Nevski), introduced into Oregon in the late 19th century, has successfully invaded the annual-dominated rangeland of northcentral California and spread into eastern Oregon and western Idaho. Infestations have reached the edge of the Great Basin along the northern California-Nevada border, with the plants found most commonly in clay soils, which have a high water-holding capacity. This preference is apparently due to medusahead's greater water needs when compared with other range annuals. Medusahead is more likely to invade vertisol sites populated by sparse native plant communities than more complex low sagebrush (Artemisia arbuscula Nutt.) or low sagebrush-woodland communities on similar clay soils. However, medusahead can invade and occupy these more complex communities if they are degraded to a low seral state. Plant communities in which big sagebrush (Artemisia tridentata Nutt.) is dominant and soil texture ranges from medium to coarse prove very resistant to medusahead invasion. Although medusahead might appear restricted to certain soil and vegetation assemblages, site degradation coupled with favorable fall and spring precipitation enhance its probability of becoming established. (Carr-Arizona)
W71-00693

NITROGEN AND PHOSPHORUS FERTILIZATION FOR PRODUCTION OF CRESTED WHEATGRASS AND NATIVE GRASS IN NORTHEASTERN MONTANA,
Agricultural Research Service, Bozeman, Mont. Northern Plains Branch; and Montana Agricultural Experiment Station, Bozeman.
A. L. Black.
Agronomy Journal, Vol 60, No 2, p 213-216, March-April 1968. 8 tab, 15 ref.

Descriptors: *Wheatgrasses, *Nitrogen, *Phosphorus, *Fertilization, *Soil water, Montana, Arid lands, Semiarid climates, Forage grasses, Forages, Fertilizers, Crop response, Crop production, Efficiencies, Range grasses, Range management, Grama grasses, Water utilization, Plant growth, Nutrients.
Identifiers: *Water-use efficiency.

A field of crested wheatgrass (Agropyron desertorum (Fisch.) Schult., 'Standard') and adjoining native rangeland was treated with N and N-P fertilizers during the years 1961-1964. Fertilization consistently increased forage yields on both sites, with the greatest response occurring the year of fertilization. Residual effects were present and significant 1 to 2 years later, however. Plant P content increased substantially when P was applied the first year and 3 years later, regardless of any N treatment. When N was applied at a rate of 45 kg/ha or greater, water-use efficiency of both grasses increased 1.5 to 2.5-fold for 2 or 3 years. This occurred regardless of P treatment. Increase in water-use efficiency appeared to be partially due to more efficient extraction of subsoil water. When N was applied alone at rates of 45 or 90 kg/ha over the 4-year study period, plant recovery of N averaged 65.8% for crested wheatgrass and over 60.0% for native grasses (Agropyron smithii Rydb., Stipa viridula Trin., and Bouteloua gracilis (H.B.H.) Lag.). However, when N and P were applied together recovery of N was greater (73.1%) for crested wheatgrass, but less (38.2%) for native grasses. N application increased crude protein production for both grasses. (Carr-Arizona)
W71-00695

RESTING ROOTS OF PINUS HALEPENSIS: STRUCTURE, FUNCTION, AND REACTION TO WATER STRESS,
Hebrew Univ., Jerusalem (Israel). Dept. of Plant Physiology.
B. Leshem.
Research grant No. 10-FS-7 from the Forest Service, U.S. Department of Agriculture. Botanical Gazette, Vol 131, No 2, p 99-104, June 1970. 7 fig, 2 tab, 25 ref.

Descriptors: *Pine trees, *Root systems, *Moisture stress, *Semiarid climates, *Soil-water-plant relationships, Soil moisture, Soil water, Water stress, Plant growth, Plant physiology, Phenols, Irrigation, Lignins.
Identifiers: *Aleppo pine, *Resting roots, *Israel, *Metacutization, Tissue, Apical meristem, Soil water potential.

Aleppo pine (Pinus halepensis Mill.), found in subhumid to semiarid Mediterranean regions, ceases most root growth as summer approaches. The roots enter a resting state in which metacutization occurs. This is a special chemical process of lignification and suberization taking place in the cortex and dormant root cap. Compared with growing roots, the meristematic region of the resting roots were greatly reduced and heterogeneous and were completely surrounded by the metacutis. Metacutization developed in the outer cells of the phenol-containing zones of the apical meristem, forming a layer between the meristematic and mature tissues. The metacutis was found to be of no value as a protective sheath. Metacutization could be induced by lowering soil water potential to -7 bars, but root growth resumes, even in dry summers, after irrigation. (Carr-Arizona)
W71-00697

HOMOCLIMES AND INTRODUCTION OF TREES AND SHRUBS WITH SPECIAL REFERENCE TO THE ARID AND SEMI-ARID ZONE OF INDIA,
Forest Research Inst., Dehra Dun (India). Coll. of Forest Education; Central Arid Zone Research Inst., Jodhpur (India). Div. of Resource Utilization Studies; and Andhra Univ., Waltair (India). Dept. of Meteorology and Oceanography.
R. C. Kaushik, R. N. Kaul, and V. P. Subrahmanyam.
Indian Forester, Vol 95, No 5, p 283-292, May 1969. 2 tab, 26 ref.

Descriptors: *Evapotranspiration, *Forests, *Arid lands, *Climatic zones, *Climatic data, Temperature, Heat balance, Water balance, Semiarid climates, Trees, Shrubs, Zerophytes, Vegetation establishment.
Identifiers: *Introduced plants, *Potential evapotranspiration, *Climatic classification, *Homoclimes, *India, Megathermals.

Some theories on the nature of correlations between vegetation zones and climatic factors are briefly reviewed and 2 systems of climatic classification are discussed in some detail. Koppen's system recognized the inadequacy of identifying climatic regions by temperature and rainfall data, but failed to evaluate adequately the heat factor in climate. Thornthwaite's system utilized a central parameter-potential evapotranspiration, which, because of its dependence on energy balance, serves as both a moisture and a temperature index. It is recognized that seasonal variation of effective moisture has a profound influence in the development of climatic climaxes in the evolution of vegetation. In discussing the introduction of tree and shrub species into arid and semiarid zones, it is therefore important to match climatic factors from various parts of the world where the introduced species are native. Accompanying tables list varieties of tree and shrub species which might profitably be introduced into Indian arid regions and corresponding world homoclimes. (Casey-Arizona)
W71-00699

SOIL MOISTURE EFFECTS ON COMPETITIVE ABILITY OF WEEDS,
Southwestern Great Plains Research Center, Bushland, Tex.
For primary bibliographic entry see Field 02G.
W71-00701

IRRIGATION STUDIES ON COTTON: II. BOLL WEIGHT AND FIBRE PROPERTIES,
Central Arid Zone Research Inst., Jodhpur (India).
For primary bibliographic entry see Field 03F.
W71-00703

IRRIGATION STUDIES ON COTTON IN ARID ZONE: I. EFFECT OF VARIOUS METHODS OF IRRIGATION AND LEVELS OF SOIL MOISTURE ON GROWTH AND YIELD OF THREE VARIETIES OF COTTON,
Central Arid Zone Research Inst., Jodhpur (India).
For primary bibliographic entry see Field 03F.
W71-00704

ADHESIVE HYDROCOLIOIDS SECRETED BY MICROSCOPIC MARINE ALGAE,
Naval Civil Engineering Lab., Port Hueneme, Calif.
Harold P. Vind.
Available from NTIS as AD-867 080, $3.00 in paper copy, $0.95 in microfiche. February 1970. 46 p. Technical Note N-1077.
Identifiers: *Fouling, Algae, *Algae, Adhesion, *Adhesives, Secretion, Gels, Proteins, Polymers, Polysaccharides, Alginic acid, Marine biology, Colloids, Spectra (Infrared), *Hydrocolloids, Carrageen.

The adhesion of microscopic marine algae to the walls of small containers of sea water has been studied. Infrared spectra of extracts and films of algae

were analyzed and compared to spectra of known hydrocolloids. The studies indicate that the gels holding algae together in films are composed primarily of polysaccharide polymers similar to the seaweed hydrocolloids, carrageenan and alginic acid, but that the adhering layer of substance joining algae to foreign surfaces is mostly protein. Like all proteins in their native states, it is also a hydrocolloidal gel. Recognition that adhesive systems of marine fouling organisms are hydrocolloidal gels tells a great deal about their nature and delineates the most logical areas in which to undertake research on methods to prevent attachment of fouling organisms.
W71-00817

INTERCEPTION OF PRECIPITATION BY VEGETATION,
Forest Service (USDA), Franklin, N.C. Southeastern Forest Experiment Station.
J. D. Helvey.
In: Representative and Experimental Basins, An International Guide for Research and Practice, UNESCO Studies and Reports in Hydrology 4, 1970, p 89-92.

Descriptors: *Interception, *Rainfall, *Throughfall, *Stemflow, *Design criteria, Instrumentation, Measurement, Reliability, Statistical methods, Watershed management, North Carolina.
Identifiers: Net rainfall, Litter interception.

Guidelines are presented for designing studies of rainfall interception loss in forest stands. The spatial variability of each interception parameter is used to determine the size of the gaging network necessary to achieve a desired sample accuracy. (Helvey-Forest Service)
W71-00915

WATER BALANCE IN THE WHIPSCORPION, MASTIGOPROCTUS GIGANTEUS (LUCAS) (ARACHNIDA, UROPYGI),
Arizona State Univ., Tempe. Dept. of Zoology.
Gregory A. Ahearn.
Comparative Biochemistry and Physiology, Vol 35, No 2, p 339-353, 15 July 1970. 6 fig, 2 tab, 49 ref.

Descriptors: *Water balance, *Water loss, *Cuticle, *Animal physiology, Invertebrates, Respiration, Arizona, Temperature, Humidity, Arid lands, Transpiration, Weight, Environmental effects, Absorption, Xerophilic animals.
Identifiers: *Arachnida, *Whipscorpion, *Terrestrial arthropod water balance, Oxygen consumption, Arthropod transpiration, Integument, Cuticular water loss, Dessication.

Studies on rates of water loss in arachnids have indicated differences between temperate and desert forms. In specimens of an Arizona mesic form, the whipscorpion, measured water loss under controlled environmental conditions near zero percent relative humidity was exponentially related to weight with the heavier animals losing the least. With temperature ranging over 20-40 degrees centigrade, rates of transpiratory water loss (integumentary and respiratory components) increased gradually to 37.5 degrees and suddenly elevated 3-fold. This probably represented breakdown of a waterproof cuticle since water loss rates above 37.5 degrees were much greater than increases in oxygen consumption. At high relative humidities water loss was low but became linear with time at lower levels. Animals between 0.1-2.0 grams on saturated sponges recovered large proportions of water lost by predessication within 2 hours while larger specimens gained nothing. Apparently water uptake from moist substrates is active, involving drinking and possibly cuticular absorption. Comparisons with data on xeric arachnids indicates there may be an order of magnitude difference in water loss between xeric and mesic forms, the loss being greater in mesic forms. (Casey-Arizona)
W71-00948

THE WATER ECONOMY OF THE SAGE SPARROW, AMPHISPIZA BELLI NEVADENSIS,
Oregon State Univ., Corvallis. Dept. of Zoology.
Ralph R. Moldenhauer, and John A. Wiens.
Supported by the National Science Foundation (Grant GB-6606). Condor, Vol 72, No 3, p 265-275, July 1970. 5 tab, 2 fig, 29 ref.

Descriptors: *Birds, *Xerophilic animals, *Ecology, *Animal behavior, *Water conservation, Arid lands, Moisture stress, Osmotic pressure, Animal physiology, On-site investigations, Laboratory tests, Saline water, Water loss, Water requirements, Water balance, Thermal stress, Weight.
Identifiers: *Succulents, Sage Sparrows.

Physiological and behavioral studies were undertaken to determine any adaptations peculiar to desert life in the xerophilic Sage Sparrow. Normal ad libitum water intake in captive birds was about 100 percent body weight per day and fecal drop moisture content was about 76 percent. Restricted to succulents, normal body weight was maintained on lettuce (95 percent water) and Tenebrio larvae (60 percent), and fecal water content was about 66 percent. When confined to a dry diet without water, motor activity increased, food intake decreased, gradual weight loss occurred and the birds died in 8 days. Two factors determine a bird's ability to survive on saline water: (1) Tolerance of high blood osmotic pressures (2) Renal concentration capacity. In both, Sage Sparrows are unexceptional. Individuals lost weight on NaCl drinking solutions of 0.25 molar or more and maximum urine-plasma chloride ion ratio was 2.4. Field studies showed that breeding birds satisfied their summer water demands by eating succulent vegetation and insects. Behavioral responses lead to avoidance of heat stress with consequent body water conservation. This compensates for the lack of any unique physiological water conservation mechanisms. (Casey-Arizona)
W71-00949

THE STATUS OF SUMMER ANNUALS IN PALESTINE,
Hebrew Univ., Jerusalem (Israel). Dept. of Botany.
M. Negbi.
Israil Journal of Botany, Vol 17, No 4, p 217-221, 1968. 1 tab, 20 ref.

Descriptors: *Desert plants, *Soil moisture, *Arid lands, *Deserts, *Environment, Habitats, Summer, Semiarid climates, Plant physiology, Germination, Seeds, Migration, Ecological distribution.
Identifiers: *Summer annuals, *Israel, *Central Asia, *Near East, *Adaptation, Seedlings.

A habitat study of summer annuals in Israel reveals that 45 per cent of the plants grow in dry habitats where winter rainwater is stored in the soil for summer use. Dispersal, germination, and seedling establishment of five desert annuals (Salsola inermis Forssk., Salsola volkensii Schweinf. et Aschers., Salsola kali L., Aellenia autrani (Post) Zoh., and Kochia indica Wight) are discussed in order to illustrate their adaptation to their arid environment. Based on a study of migration and distribution of Kochia indica and Salsola kali, the author presents a hypothesis for the Central Asiatic origin of summer annuals endemic to the Near Eastern deserts. (Carr-Arizona)
W71-00950

THE VEGETATION OF SARATOGA SPRINGS, DEATH VALLEY NATIONAL MONUMENT, CALIFORNIA,
Nevada Southern Univ., Las Vegas. Dept. of Biological Sciences.
W. Glenn Bradley.
U.S. National Park Service Contract No 14-10-0434-1989. Southwestern Naturalist, Vol 15, No 1, p 111-129, June 1, 1970. 4 fig, 7 tab, 12 ref.

Descriptors: *Xerophytes, *Phreatophyes, *Marsh plants, *Plant populations, *Environmental gradient, Arid lands, California, On-site investigations, Halophytes, Saline soils, Standing crop, Water demand, Sampling, Vegetation, Distribution patterns, Frequency, Salt marshes.
Identifiers: *Species diversity, *Death Valley, Plant cover, Plant communities, Perennial.

A study was made of the perennial vegetation of a spring-fed salt marsh and its adjacent environment. The vegetation of the area forms a mosaic of plant communities with sharp boundaries. Three major vegetation types occur--xeric shrub, phreatophyte and salt marsh. The species and distributions of each are described. In species diversity, the xeric shrub communities are depauperate, reflecting the harsh physical conditions under which they survive. The phreatophyte communities are more diverse and occur in areas where the water table is high. The standing crops of all 3 communities were estimated and the value for the salt marsh community was by far the greatest. This was reflected in a comparison of the communities along a moisture gradient in which the salt marsh community also had the greatest number of perennial species and percent of cover. Salinity gradients and water gradients are apparently the crucial factors in vegetation distribution and are responsible for the sharp boundaries of the community mosaic. (Casey-Arizona)
W71-00953

FIELD STUDIES ON THE SANDGROUSE OF THE KALAHARI DESERT,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Zoology.
Gordon L. Maclean.
Supported by U.S. Public Health Service Grant ES 00008 (Environmental Health). In: The Living Bird-7th Annual of the Cornell Laboratory of Ornithology, p 209-235, 1968. 17 fig, 1 tab, 45 ref.

Descriptors: *Birds, *Ecology, *Arid lands, *Temperature, *Regulation, *Water requirements, Breeding, Calcareous soils, Dunes, Semiarid climates, Seeds, Surface waters, On-site investigations, Saline water, Habitats, Dry seasons, Cooling, Animal physiology.
Identifiers: *Africa, *Kalahari Desert, *Gular fluttering, *Sandgrouse.

The Namaqua Sandgrouse (Pterocles namaqua live in shrubby calcrete along river banks while the Spotted Sandgrouse (P. burchelli) live in the grassy dunes of the Kalahari Desert. Both species capitalize on the most abundant food in deserts-dry seeds. Unlike insectivorous birds, however, they are dependent upon free surface water and must often travel long distances for it. A 100-mile round trip is a probable maximum breeding range. Drinking is usually done in flocks at consistent morning hours. Gular fluttering is the sole physiological cooling mechanism and appears to be highly efficient. Behavioral cooling and breeding mechanisms are described. Only the breeding habits of manaque have been observed, and it may breed at any time of the year but usually does so during the dry season. The male wets his breast feathers at a pond and flies to the young, supplying them with water. These species may be affected by the increases of waterholes due to human activities. (Casey-Arizona)
W71-00954

THE NOCTURNAL BEHAVIOUR OF XEROPHYTES GROWN UNDER ARID CONDITIONS,
Colorado State Univ., Fort Collins. Dept. of Watershed Resources.
I. Gindel.
New Phytologist, Vol 69, No 2, p 399-404, April 1970. 2 tab, 25 ref.

Descriptors: *Transpiration control, *Stomata, *Xerophytes, *Arid lands, *Soil-water-plant relationships, Moisture deficit, Dew, Humidity, Field capacity, Wilting point, Plant physiology, Plant groupings, Laboratory tests, Leaves, Nocturnal, Diurnal, Hydrogen ion concentration, Alfalfa.
Identifiers: *Relative humidity, Eucalyptus.

Nighttime leaf stomatal closure has long been thought universal in plants and a result of increased guard cell pH due to carbon dioxide accumulation. The stomatal apertures of 78 indigenous and introduced woody xerophytes grown under arid, water deficient conditions were measured in the dark and in daylight. As a percentage of total leaf area, stomatal openings were 0.017-0.122 during the day and 0.155-0.471 at night. Openings were evident during nights with dew and high relative humidity but not when relative humidity dropped to 30-40 percent. Four species (alfalfa and 3 Eucalyptus species) were pot-grown in 2 groups, one at wilting point and the other at field capacity. A much greater percentage of stomatal openings occurred in the moisture deficit group. Apparently stomatal opening in xeromorphic plants is strongly influenced by water deficit. (Casey-Arizona)
W71-00955

THE EFFECT OF NITROGEN SUPPLY ON TRANSPIRATION AND STOMATAL BEHAVIOUR OF BEANS (PHASEOLUS VULGARIS L.),
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
For primary bibliographic entry see Field 02D.
W71-00956

THE EFFECT OF NITROGEN SUPPLY ON SOME INDICES OF PLANT-WATER RELATIONS OF BEANS (PHASEOLUS VULGARIS L.),
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
For primary bibliographic entry see Field 02D.
W71-00957

IRRIGATED CASTORBEAN, SOYBEAN, AND SAFFLOWER TRIALS AT THE NORTHEASTERN BRANCH STATION,
New Mexico Agricultural Experiment Station, University Park.
David H. Williams.
March 1968, 12 p, 13 tab. Research Report 133.

Descriptors: *Irrigation effects, *Crop production, *Plant growth, *New Mexico, Disease resistance, Soybeans, Arid lands, Leaves, Plant pathology, On-site tests, Seeds, Data collections, Seeds, Climatic data.
Identifiers: *Castorbeans, *Safflower, Tucumcari (New Mexico), Commercial production, Leaf disease, Root disease, Seed shattering, Trials, Hulling.

Irrigated variety trials of castorbeans, soybeans and safflower were conducted at the Northeastern Branch Station, Tucumcari, New Mexico. Materials, methods and results are discussed for each crop. This study was undertaken because local producers expressed interest in finding crops to supplement sorghum and alfalfa. Tables include data on yields, hulling percentages, height, shattering, date of 10-percent flowering (safflower), cultural practices, climatic conditions and disease damage (safflower) for castorbean (1953-1962), soybean (1955-1964) trials. Castorbean yields indicate the crop is well adapted for commercial production in this area. No variety, strain or hybrid consistently produced outstandingly high yields. Baker 296 is the only tested variety which should not be grown due to leaf-disease susceptibility. Seed shattering was a major problem in the soybean trials. Lee was the only variety which exhibited a high and prolonged shatter resistance. Favorable yields were obtained, showing Lee is adapted for production in this area. Safflower should not be grown under irrigation here because of severe root disease. (Popkin-Arizona)
W71-00964

WATERFOWL - WATER TEMPERATURE RELATIONS IN WINTER,
Colorado State Univ., Fort Collins. Natural Resources Center.
Ronald A. Ryder.
Available from NTIS as PB-195 612, $3.00 in paper copy, $0.95 in microfiche. Colorado State University Environmental Resources Center Completion Report Series No 21, June 30, 1970. 60 p, 53 fig, 11 tab, 10 ref. OWRR A-006-COLO (3).

Descriptors: *Water temperature, *Climates, *Ducks (Wild), *Overwintering sites, Aquatic life, Waterfowl, Environment, Aquatic environment, Aquatic habitats, Wildlife habitats, Cold regions, Migration patterns, Migratory birds.
Identifiers: Water temperature - wildfowl relations.

A study was conducted in Larimer County, Colorado, 1967-70, to investigate the ability of waterfowl to winter north of the 0 degree C isotherm. Ground and aerial counts were made of selected duck and goose concentration areas where waterfowl maintained patches of open water. The number of birds using an area and the size of the area were estimated from aerial photographs. The area of open water per bird and ambient temperature appear to be directly related. Ten 3-hour experiments were conducted with captive, wild Mallards in a controlled temperature, cold room to determine the effect of ducks on low water temperatures. Ducks under test conditions produced significantly more heat than ducks under control conditions. The test condition metabolism represented an increase of 22.7 percent over the control metabolism. Nocturnal behavior of Redhead ducks on a pond was observed during freezing weather. Activity was greater at night during freezing weather than during warmer weather. Duck defecation rates and chemical content of feces were determined from captive ducks. (Knapp-USGS)
W71-01054

2J. Erosion and Sedimentation

DETACHMENT OF SOIL AGGREGATES BY SIMULATED RAINFALL,
Nebraska Univ., Lincoln. Dept. of Agronomy.
Andrew P. Mazurak, and Peter N. Mosher.
Soil Science Society of America Proceedings, Vol 34, No 5, p 798-800, September-October 1970. 3 p, 3 fig, 1 tab, 7 ref.

Descriptors: *Soil erosion, *Soil amendments, *Impact (Rainfall), Soil structure, Soil stability, Soil management, Soil stabilization, Soil texture, Puddling, Rainfall simulators, Soil surfaces.
Identifiers: Clod strength.

Detachment of naturally occurring soil aggregates when exposed to simulated rainfall increased from 76 mg of particles per cc of water to a maximum amount of 172 mg/cc as the diameters of aggregates decreased from 9,250-4,760 microns to 2,360-1,680 microns. Then, the amount of splashed soil particles decreased as the diameter of aggregate decreased. Addition of Krilium to aggregates reduced the amount of splash for aggregate fractions larger than 420 microns in diameter but increased the amount for fractions smaller than 420 microns in diameter. (Knapp-USGS)
W71-00556

STABILITY OF A SAND BED SUBJECTED TO A SHEAR FLOW OF LOW FROUDE NUMBER,
Washington Univ., Seattle. Dept. of Oceanography.
J. Dungan Smith.
Journal of Geophysical Research, Vol 75, No 30, p 5928-5940, October 20, 1970. 13 p, 10 fig, 1 tab, 18 ref. AEC Contract AT (45-1)-1752 (ref. RL0-1752-9).

Descriptors: *Sediment transport, *Bed load, *Shear drag, *Froude number, *Sand waves, Dunes, Ripple marks, Critical flow, Transition flow, Velocity, Turbulent flow, Open channel flow, Alluvial channels, Sands, Viscosity, Hydraulics, Hydrodynamics, Sedimentary structures.
Identifiers: Sand-bed stability, *Shear flow.

The problem of sand bed stability is formulated and solved for a model in which the local slope of the free surface is small relative to the slope of the perturbed lower boundary. The solution shows the bed to be unstable to perturbations of wavelength greater than the wavelengths for which the inertia of the sediment grains is important. Wave speeds and growth rates from numerical calculations are presented and compared with long- and short-wave asymptotic expressions. Although the fluctuating velocity field in the nonuniform flow is approximated by a constant eddy viscosity, a general picture of the relationship between the flow over a perturbed boundary and the observed geometrical and dynamical parameters of the resulting boundary waves can be developed. It is shown that the sand bed instability is due to local accelerations of a shear flow caused by the nonuniform boundary. If either the shear or the acceleration is eliminated from the analysis, the instability cannot be found. On the other hand, no wavelength is defined by such an analysis, and it is shown that the wavelength is determined by spatial adjustments in the turbulent velocity field. (Knapp-USGS)
W71-00560

LONGSHORE SAND TRANSPORT ON BEACHES,
Scripps Institution of Oceanography, La Jolla, Calif.
Paul D. Komar, and Douglas L. Inman.
Journal of Geophysical Research, Vol 75, No 30, p 5914-5927, October 20, 1970. 14 p, 9 fig, 2 tab, 30 ref.

Descriptors: *Sediment transport, *Beaches, *Littoral drift, *Mathematical models, Shores, Surf, Waves (Water), Currents (Water), Sands, Model studies, Bed load, Sand waves, Tractive forces.
Identifiers: Longshore currents.

Simultaneous field measurements of wave and current parameters in the surf zone and the resulting longshore transport of sand were made on two beaches under a variety of conditions. The direction and flux of wave energy was measured from an array of digital wave sensors placed in and near the surf zone. Quantitative measurements of the longshore sand transport rate were obtained from the time history of the center of gravity of sand tracer. The measurements were used to test two models for the prediction of the longshore transport rate of sand. The first model gives the immersed weight longshore transport rate of sand as proportional to the longshore component of wave energy flux. The second model assumes that the waves provide the power to move and support the sand and that the superimposed longshore current provides a longshore component that results in the longshore transport of sand. Both models successfully predict the sand transport rate. The coherence of the models appears to be based on the generation of the longshore currents by the longshore radiation stress. The models will not be equivalent if the longshore current owes its origin to some other generating mechanism such as tides or winds. (Knapp-USGS)
W71-00561

AN IMPROVED METHOD FOR SIZE DISTRIBUTION OF STREAM BED GRAVEL,
Geological Survey, Washington, D.C.
Luna B. Leopold.
Water Resources Research, Vol 6, No 5, p 1357-1366, October 1970. 10 p, 6 fig, 3 tab, 10 ref.

Descriptors: *Sampling, *Gravels, *Particle size, *Statistical methods, Dimensions, Weight, Surveys, Reliability, Statistics, Data collections, Measurement, Alluvial channels, Sediment transport.
Identifiers: Sediment sampling.

Random sampling of surface rocks on a gravel bar is biased toward larger sizes which, because of their area, are more likely to be picked up. Weighting can eliminate this bias. Data on average weight of a single rock are used to change numbers of rocks to weights, thus yielding size frequency data in

general agreement with a sieved and weighed sample. The question of what to sample depends on the use to which the data are to be put, and is treated only briefly. (Knapp-USGS)
W71-00585

THE MEASUREMENT OF THE EFFECTS OF BUILDING CONSTRUCTION ON DRAINAGE BASIN DYNAMICS,
Exeter Univ. (England).
For primary bibliographic entry see Field 04C.
W71-00592

A GEOMORPHIC APPROACH TO EROSION CONTROL IN SEMIARID REGIONS,
Colorado State Univ., Fort Collins. Dept. of Geology.
For primary bibliographic entry see Field 04D.
W71-00605

EROSION PROBLEMS AND CONTROL PRACTICES ON FEDERAL DOMAIN LANDS,
Bureau of Land Management, Logan, Utah.
For primary bibliographic entry see Field 04D.
W71-00607

FACTORS AFFECTING THE TRANSFER OF MATERIALS BETWEEN WATER AND SEDIMENTS,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 02K.
W71-00618

PROBLEMS IN THE CLIMATIC GEOMORPHOLOGY OF ARID LANDS,
New South Wales Univ., Kensington (Australia). School of Geography.
J. A. Mabbutt.
Annals of Arid Zone, Vol 8, No 2, p 209-224, September 1969. 34 ref.

Descriptors: *Weathering, *Geomorphology, *Arid lands, *Climatic zones, *Land forming, Semiarid climates, Sands, Rainfall, Vegetation, Geology, Aeolian soils, Wind erosion, Classification, Paleoclimatology, Deserts, Dunes.
Identifiers: *Wadis, *Morphogenetic classification, Endoreism, Insolation weathering.

Two major problems of desert studies are: (1) The nature of the developmental processes of arid zone landforms; (2) Definitive descriptions of arid and semiarid regions. Early investigators felt that deserts were static regions consisting of relict topographical forms. Gradually, the importance of wind and water, primarily as weathering agents, has come to be recognized. It is the author's view that the physicochemical effects of water are at least as important as the physical effects, and that wind and water are complex interacting agents whose effects decrease toward the arid core areas. A number of characteristic landform phenomena are described, but their usefulness as arid zone morphoclimatic indices has been limited. Additionally, vegetation, rainfall and the presence of sand dunes are examined in terms of the delimitations and subdivisions of arid regions, but none are truly definitive. This argument is buttressed by descriptions of a wide variety of warm arid climates, many of which differ greatly in crucial descriptive parameters. There are short discussions of past climatic changes as revealed by palaeoforms and the influences of anthropogenic factors. (Casey-Arizona)
W71-00700

LANDFORMS AND CLIMATIC CHANGE IN THE KALAHARI AND NGAMILAND,
Cambridge Univ. (England). Dept. of Geography.
A. T. Grove.
Geographical Journal, Vol 135, No 2, p 191-212, June 1969. 11 fig, 39 ref.

Descriptors: *Landforming, *Aerial photography, *Geomorphology, *Semiarid climates, *Climatic data, Dune succession, Erosion, Drainage density, Hydrogeology, Structural geology, Superimposed drainage, Terrain analysis, Topography, Weathering, Pleistocene epoch, Deserts, Sands, Paleoclimatology.
Identifiers: *Africa, *Kalahari Desert, *Sahelian zone, *Alab dunes, *Calcretes.

The Kalahari Desert is grass and tree-covered with a mean annual rainfall of 150-200 millimeters but with consistent year-round water deficits due to transpiration losses. A sequence of climatic changes have occurred since the Pleistocene through the present which have strongly influenced its morphology. These changes may be similar to but more striking than those of the Sahelian Zone which lies between the Saharan and Sudan Zones. The geomorphology of the area was studied by the use of aerial photographs in an effort to trace past climatic changes. The data suggest a number of tentative theories: (1) Alab dunes, running about parallel to present day winds represent a period when annual rainfall was probably much less than one-half present rainfall; (2) Massive underlying calcretes were probably deposited since the Pliocene during various semiarid climates similar to the present; (3) A more humid period followed in which extensive rivers probably flowed toward the Ngami and Mababe depressions, guided by alab dunes, creating extensive series of lakes; (4) A more arid period followed, probably creating dunefields and sand ridges. It is concluded that the unorganized drainage networks of the present Kalahari Desert and the Sahelian Zone are characteristic of areas where aridity has been replaced by more humid conditions. (Casey-Arizona)
W71-00702

SEDIMENT DISTRIBUTION AND HYDRODYNAMICS SACO RIVER AND SCARBORO ESTUARIES, MAINE,
Massachusetts Univ., Amherst. Coastal Research Group.
Stewart C. Farrell.
Available from the NTIS as AD 709 145, $3.00 in paper copy, $0.95 in microfiche. June 1970, 142 p. Contribution No. 6-CRG. NR388-084.
Identifiers: *Hydrology, Maine, *Rivers, Sedimentation, Distribution, Geologic age determination, Environment, Sand, Particle size, Saco River estuary, Scarboro estuary, *Estuarine hydrography, *Holocene sedimentation.

Using a combination of field observations and measurements and laboratory investigation of sampled materials, this study is an attempt to discover the processes responsible for the formation of the assemblage of Holocene sediment bodies present in the Saco Bay, Maine, area. By interpreting the processes and the significant features resulting from them in this and other areas currently under study by the University of Massachusetts Coastal Research Group, a clearer picture of the complex pattern of coastal sand-body development, it is anticipated, will emerge.
W71-00797

HYDROGRAPHY AND HOLOCENE SEDIMENTATION OF THE MERRIMACK RIVER ESTUARY, MASSACHUSETTS,
Massachusetts Univ., Amherst. Coastal Research Group.
For primary bibliographic entry see Field 02L.
W71-00798

STUDY OF EROSION IN ROADSIDE DRAINAGE CHANNELS IN NORTH CAROLINA,
North Carolina State Univ., Raleigh. School of Engineering.
For primary bibliographic entry see Field 04D.
W71-00806

HEAVY MINERAL INVESTIGATION OF CARMEL BAY BEACH SANDS,
Naval Postgraduate School, Monterey, Calif.
For primary bibliographic entry see Field 02L.
W71-00809

DYNAMIC PROPERTIES OF IMMERSED SAND AT VIRGINIA BEACH, VIRGINIA,
Virginia Inst. of Marine Science, Gloucester Point.
Wyman Harrison, and Morales-Alamo Reinaldo.
Available from NTIS as AD-459 520, $3.00 in paper copy, $0.95 in microfiche. December 1964. 52 p, Army Coastal Engineering Research Center. Technical memorandum No. 9.
Identifiers: *Beaches, Sand, *Sand, Sedimentation, Sampling, Particle size, Ocean waves, Wind, Viscosity, Temperature, Sea water, Drag, Reynolds number, Velocity, Mathematical analysis, Beach erosion, Virginia Beach.

On March 25, 1963, 219 sand samples were taken from the shoaling-wave, breaking-wave, swash-backwash, and foreshore zones of the beach. The following measurements were used to describe the properties of the samples: mean settling velocity in nature (as determined with a woods hole rapid sand analyzer and a special set of curves for settling velocity as a function of temperature), mean reynolds number (in nature), and mean drag coefficient (for an infinite fluid under natural conditions). Corey's (1949) shape factor and the dynamic shape factor of Briggs, Et Al (1962) were calculated and compared; the Corey shape factor was used in calculating mean settling velocity. Data for mean and median grain size (in nominal diameter) and sorting for each sample are presented.
W71-00811

BEACH PROFILE AS AFFECTED BY VERTICAL WALLS,
California Univ., Berkeley. Hydraulic Engineering Lab.
Abdel-Latif Kadib.
Available from NTIS as AD-420 424, $3.00 in paper copy, $0.95 in microfiche. June 1963. 49 p. Corps of Engineers, Beach Erosion Board Technical Memorandum 134.
Identifiers: *Beaches, Erosion, *Levees, Models (Simulations), Water, Control, Walls, Construction, Soil mechanics, Breakwaters, Beach erosion, Shore protection.

Results of a laboratory investigation of some aspects of the flow characteristics and wave attack at sand beaches protected by a vertical seawall are reported. The effects of the top elevation of the vertical wall, bed material characteristics, and different wave scale ratios were also investigated. Some conclusions are drawn regarding relative wall height and beach profile stability in front of and behind the wall.
W71-00833

SEDIMENT BALANCE OF CLYDE ESTUARY,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02L.
W71-00844

BLACK SEA: RECENT SEDIMENTARY HISTORY,
Woods Hole Oceanographic Inst., Woods Hole, Mass.
David A. Ross, Egon T. Degens, and Joseph MacIlvaine.
Science, Vol 170, No 3954, p 163-165, October 9, 1970. 3 p, 4 fig, 9 ref. NSF Grant GA-1659.

Descriptors: *Sediment distribution, *Recent epoch, *Environmental effects, *Sedimentation rates, Sedimentary basins (Geological), Fresh water, Sea water, Organic matter, Carbonates, Carbon radioisotopes, Cores.
Identifiers: *Black Sea, Sedimentary history.

To learn the origin and history of recent sediments, a detailed oceanographic survey of the Black Sea was made in 1969 during which 60 piston, gravity, and kasten cores were obtained and studied. This article describes some of the findings. Three distinct sedimentary units can be correlated throughout the basin. Carbon-14 ages help to define the recent sedimentary history. An upper unit 30 cm thick consists of microlaminated layers of light carbonate material with intervening darker layers containing more organic material. The second unit, about 40 cm thick, has an extremely high content of organic matter. The lowest unit consists of a sequence of alternating light and dark lutite; the organic content is higher in the dark layers and carbonate content is higher in the light layers. The sedimentary sequences reflect environmental changes that occurred during the time the Black Sea was a freshwater lake when cut off from the Mediterranean (20,00 to 10,000 yr ago) by the most recent worldwide lowering of sea level and later ice melting period, and after reconnection (7,000 to 12,000 yr ago) when salt water again entered the Black Sea and slowly increased salinity. Sedimentation rates are high in eastern parts of the basin bordering mountains but relatively low in western parts where sediments are trapped in river estuaries and on the broad shelf area. (Lang-USGS)
W71-00855

A PRELIMINARY INVESTIGATION OF SUSPENDED SEDIMENTS IN KAINJI LAKE, NIGERIA,
Ife Univ. (Nigeria).
Olayinka L. Asseez.
Bulletin International Association of Scientific Hydrology, Vol 15, No 3, p 61-70, September 1970. 10 p, 5 fig, 4 tab, 11 ref.

Descriptors: *Sedimentation, *Reservoirs, *Reservoir silting, Sediment yield, Suspended load, Sediment transport, Silting, Streamflow, Discharge (Water), Sediment discharge.
Identifiers: Kainji Lake (Nigeria), Niger River.

The suspended load of eight major western rivers flowing into Kainji Lake, Nigeria was determined as a part of the investigation of the suspended sediment of the reservoir. On whole the results of this study is in agreement with the previous conclusion that the sediment load of the Niger was low. A range of 29-221 ppm was observed within the reservoir whereas the concentration in the inflowing rivers varied from 122-953 ppm. It was however not possible to determine the total sediment load because discharge data were lacking. The overall rate of silting is slow but locally high rate of sediment supply gives cause for anxiety regarding the possible growth of deltas at the mouths of the river. (Knapp-USGS)
W71-00857

BED LOAD DISCHARGE OF THE RIVER TYNE, ENGLAND,
Newcastle-upon-Tyne Univ. (England). Dept. of Civil Engineering.
T. C. Muir.
Bulletin International Association of Scientific Hydrology, Vol 15, No 3, p 35-39, September 1970. 5 p, 3 fig, 1 tab, 13 ref.

Descriptors: *Bed load, *Alluvial channels, *Sediment transport, Sampling, Surveys, Equations, Sediment discharge, Suspended load, Discharge (Water), Sediment load, Duration curves, Particle size, Stage-discharge relations.
Identifiers: Meyer-Peter and Muller formula, England, River Tyne.

Bed load movement was studied at the Bywell cableway gaging station on the River Tyne in Northern England. Bed load rating curves are derived using several bed load discharge formulae. Average annual bed load discharges are computed from long-term flow records. The results of the Meyer-Peter and Muller equation, showing an average annual bed load discharge of 14,900 tons (approximately 11% of the average annual suspended sediment load), are considered to be the most reliable. (Knapp-USGS)
W71-00859

FACTORS CONTROLLING THE GEOMETRY OF FLUVIAL MEANDERS,
East Pakistan Univ., of Engineering and Technology, Dacca. Dept. of Civil Engineering.
M. Shahjahan.
Bulletin International Association of Scientific Hydrology, Vol 15, No 3, p 13-24, September 1970. 12 p, 9 fig, 1 tab, 15 ref.

Descriptors: *Meanders, *Channel morphology, *Sediment transport, Alluvial channels, Sedimentation, Discharge (Water), Streamflow, Velocity, Sediment load, Bed load, Slopes, Sediment discharge.
Identifiers: Meander geometry.

The geometry of a meandering stream depends strongly on the relative stream size, on the valley slope, Sv, and on the charge, Qs/Q, where Q and Qs are the fluid and sediment discharges respectively, and D is the mean sediment size. The geometry depends less strongly on the relative settling size of sediment. For constant values of Q, Sv and D, the effect of increase of charge reduces the meander length, ML, and the mean channel surface width, B, whereas meander width, MB, bend radius, RM, and mean channel depth, H, increase. For a constant value of relative stream size the values of ML, MB, RM, and B increase with the increase of valley slope but the value of H tends to decrease. (Knapp-USGS)
W71-00862

THE INFLUENCE OF DEPOSIT-FEEDING ORGANISMS ON SEDIMENT STABILITY AND COMMUNITY TROPHIC STRUCTURE,
Yale Univ., New Haven, Conn. Dept. of Geology and Geophysics; and Marine Biological Lab., Woods Hole, Mass.
For primary bibliographic entry see Field 02L.
W71-00869

ORGANIZING FOR SOIL EROSION AND SEDIMENT CONTROL IN OUR NATIONS URBAN AREAS,
National Association of Counties Research Foundation, Washington, D.C.
For primary bibliographic entry see Field 05G.
W71-00877

RIVERS OF DUST.
For primary bibliographic entry see Field 02B.
W71-00886

HOLOCENE SEDIMENTS OF THE PARKER RIVER ESTUARY, MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Geology.
For primary bibliographic entry see Field 02L.
W71-00900

CHARACTERIZATION OF BOTTOM SEDIMENTS: CATION EXCHANGE CAPACITY AND EXCHANGEABLE CATION STATUS,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Soils and Crops.
For primary bibliographic entry see Field 02K.
W71-01059

MEANDER GEOMETRY ARISING FROM VARYING FLOWS,
Hydraulics Research Station, Wallingford (England).
Peter Ackers, and F. G. Charlton.
Journal of Hydrology, Vol 11, No 3, p 230-252, September 1970. 23 p, 6 fig, 1 tab, 24 ref.

Descriptors: *Channel morphology, *Meanders, *Alluvial channels, *Hydraulic models, Sands, Discharge (Water), Sediment transport, Sedimentation, Bed load, Streamflow, Stage-discharge relations, Geomorphology, Channel erosion, Scour, Regime, Model studies, Steady flow, Unsteady flow.
Identifiers: Meander geometry.

Experimental research on meandering channels, carried out in a large bed of sand at Wallingford, included tests with cyclic varying discharges. Comparisons of meander length with experiments under steady conditions provide information on the 'formative' or 'dominant' discharge. Field data used for comparison include mean discharge, average flow in the month of maximum flow, mean annual flood, and bank-full discharge. This tends to confirm bank-full flow as the condition which generates the characteristic meander length. (Knapp-USGS)
W71-01061

EFFECTS OF ORGANIC ACIDS ON THE FLOCCULATION OF SUSPENDED SEDIMENTS IN TROPICAL MAN-MADE LAKES,
Ife Univ. (Nigeria).
For primary bibliographic entry see Field 02H.
W71-01062

COMPUTATION OF STABLE CANAL BEDS IN WEAK, FINE-GRAINED GROUND,
N. V. Lapturev.
Translation from Gidrotekhnika i melioratsiya, No 10, p 26-33, 1969. Soviet Hydrology: Selected Papers, Issue No 3, p 320-327, 1969. 8 p, 1 fig, 2 tab, 7 ref.

Descriptors: *Streambeds, *Channel flow, *Hydraulics, *Sedimentation, *Mathematical studies, Equations, Deposition (Sediments), Particle size, Sedimentary structures, Sediment distribution, Erosion, Foreign projects, Alluvial channels, Scour, Stream erosion.
Identifiers: Stable streambed, Fine-grained bottom, USSR.

Methods for computing parameters in determining particle size of stream (or canal) beds are presented. The main and determining factor in the formation of a river channel is water discharge with which all the other hydraulic elements are closely associated. In the particular case of canals of irrigation systems on lowland rivers investigated from a laboratory analysis of field observations, equations were formulated from relationships for stream depth, flow velocity, channel width, wetted perimeter, hydraulic radius, channel slope, maximum stream depth, the Chezy coefficients, and the fall velocity of the particles in the stream. Computations agree reasonably well with the results of field observations (which are included in the report). The methods recommended by existing standards for computing the beds of canals have significant shortcomings. In some cases, as when canals cross noncohesive fine-grained ground, these shortcomings can lead to inaccurate solutions, excessive construction work, and great costs in maintaining the canal beds in good repair during operation. The relationships obtained here for computing erosion- and silt-stable canal beds will not only simplify the method of hydraulic computations, but improve its accuracy. (Woodard-USGS)
W71-01094

2K. Chemical Processes

SOLUBILITY AND HYDROLYSIS OF ALUMINUM IN SOIL SOLUTIONS AND SATURATED-PASTE EXTRACTS,
Auburn Univ., Ala. Dept. of Agronomy and Soils.
John S. Richburg, and Fred Adams.
Soil Science Society of America Proceedings, Vol 34, No 5, p 728-734, September-October 1970. 7 p, 2 fig, 7 tab, 32 ref.

Descriptors: *Hydrolysis, *Aluminum, *Soil chemistry, Solubility, Chemical reactions, Computer programs, Hydrates, Molecular structure, Soil analysis, Soil structure.
Identifiers: Aluminum ion activities (Soils), Cations, Soil chemical activity.

Three Coastal Plains soils with different 'critical' pH values for maximum cotton yields in field experiments were analyzed for Al solubility. Fertilized soil was used to verify critical pH by a root-growth experiment in a growth-chamber, as well as to obtain displaced soil solutions and water extracts from saturated pastes. Extracts were also obtained from saturated pastes made with 0.01M and 0.05M KCl and with 0.0033M and 0.0167M CaCl2. Solutions were analyzed for pH, Ca, Mg, Mn, K, NH4, Al, and SO4; the remaining ions required for electrical neutrality were assumed to be Cl and NO3. A computer program was used to solve for ion activities and ion-pair concentrations, including various Al-ion species. Calculated values were much lower for polymeric hydrolysis than for monomeric hydrolysis. (Knapp-USGS)
W71-00553

OXYGEN AND HYDROGEN ISOTOPE RATIOS OF MONTHLY COLLECTED WATERS FROM NASUDAKE VOLCANIC AREA, JAPAN,
Tokyo Univ. of Education (Japan). Dept. of Chemistry; and Tokyo Univ. (Japan). Ocean Research Inst.
Minoru Kusakabe, Hiroaki Wada, Sadao Matsuo, and Yoshio Horibe.
Journal of Geophysical Research, Vol 75, No 30, p 5941-5951, October 20, 1970. 11 p, 9 fig, 2 tab, 24 ref.

Descriptors: *Stable isotopes, *Deuterium, *Thermal water, *Volcanoes, Magmatic water, Hot springs, Water chemistry, Water sources, Steam, Radioisotopes, Surface waters, Rainfall, Precipitation (Atomospheric), Tracers, Geochemistry, Groundwater movement.
Identifiers: *Oxygen isotopes, *Fumaroles.

Monthly variation of oxygen isotopes of two fumarolic condensates, five hot spring waters, two stream waters, and meteoric precipitation at the Nasudake volcanic area of Japan was measured. There was no remarkable variation with time in the isotopic ratios of the samples except for meteoric precipitation and for one of the hot spring waters. The delta D and delta O-18 of meteoric precipitation showed seasonal change with summer maximum and winter minimum. The D and O-18 of the stream waters and two of the hot spring waters were identical with those of average precipitation. The residence time of precipitation water under the ground was calculated to be not shorter than a few years. Precipitation did not directly affect the isotopic ratios of volcanic waters. Deuterium content of thermal waters was found to be higher than that of surface waters by 7 parts per thousand on the average. This slight enrichment of deuterium was inferred to be due to subsurface clay formation. (Knapp-USGS)
W71-00559

AN AIRBORNE MEASUREMENT OF THE SALINITY VARIATIONS OF THE MISSISSIPPI RIVER OUTFLOW,
Lockheed Electronics Co., Houston, Tex., and National Aeronautics and Space Administration, Houston, Tex.
J. D. Droppleman, R. A. Mennella, and D. E. Evans.
Journal of Geophysical Research, Vol 75, No 30, p 5909-5913, October 20, 1970. 5 p, 5 fig, 1 tab, 2 ref.

Descriptors: *Salinity, *Mississippi River, *Remote sensing, *Microwaves, *Electromagnetic waves, Radio waves, Radiation, Aircraft, Instrumentation, Radar, Measurement.
Identifiers: Passive microwave measurements, Radiometry.

Passive microwave radiometric measurement of salinity variations were made at the south and southwest passes of the Mississippi River on September 27, 1969. The passive microwave system can measure radiometric energy in four bands centered on 1.4, 10.6, 22.2, and 31.4 GHz. No radiometric temperature change (within instrumental limits) was observed with the 10.6-, 22.2-, or the 31.4-GHz radiometers. A radiometric change of 13--18 deg K was observed with the 1.4-GHz radiometer. This observed change and the absence of an observed change by the other channels agrees (within experimental limits) with the theoretically predicted radiometric temperature variation for water at 25 deg C. This measurement demonstrates that an airborne passive microwave radiometer operating at 1-1.5 GHz can rapidly measure salinity and variations in salinity over large areas. (Knapp-USGS)
W71-00562

REMOTE ANALYSIS OF FLUORESCENCE BY A FRAUNHOFER LINE DISCRIMINATOR,
Geological Survey, Washington, D. C.; and Perkin-Elmer Corp., Norwalk, Conn.
George E. Stoertz, William R. Hemphill, and David A. Markle.
Reprint of Paper presented at Marine Technology, 1970, Marine Technology Society 6th Annual Conference, Wash, DC, June 29-July 1, 1970. Vol 2, 22 p, 13 fig, 1 tab, 30 ref.

Descriptors: *Remote sensing, *Fluorometry, *Dye releases, *Tracking techniques, Optical properties, Fluorescence, Instrumentation, Photometry, Path of pollutants, Dispersion, Water pollution sources.
Identifiers: Rhodamine WT.

A prototype Fraunhofer line discriminator (FLD), an optical instrument for remote detection of substances that fluoresce when irradiated by sunlight, operates at the sodium D2 line (5890 A), automatically measuring solar-stimulated fluorescence against a background of reflected sunlight. Over water it functions as an airborne or shipboard fluorometer, measuring substances that fluoresce amber, such as rhodamine dyes. The FLD detected Rhodamine WT in a tank of water 1/2-meter deep in concentrations as small as 1 ppb. Shipboard and helicopter tests show that the dye normally can be monitored in concentrations less than 5 ppb, whether in clear river water, moderately turbid marine coastal water, or highly turbid estuaries. Tests to altitudes of 5,000 feet show little loss of sensitivity. Applications of the FLD include sensing fluorescent dye in studies of current dynamics and dispersion. Use of other lines may permit monitoring of oil spills, detergents, algal blooms, distribution of phytoplankton, and fluorescent chemicals such as lignin sulfonates, associated with pulp- and paper-mill wastes. (Knapp-USGS)
W71-00565

AN APPROACH TO RESERVOIR TEMPERATURE ANALYSIS,
Army Corps of Engineers, Sacramento, Calif., Hydrologic Engineering Center.
For primary bibliographic entry see Field 02H.
W71-00567

VERTICAL TEMPERATURE STRUCTURE AND WATER SURFACE HEAT EXCHANGE,
Pennsylvania Univ., Pa.
For primary bibliographic entry see Field 02H.
W71-00568

SALINE GROUNDWATER RESOURCES OF THE CONTERMINOUS UNITED STATES,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 03C.
W71-00574

PLAYA WATER QUALITY CHANGES WITH TIME AND EFFECTS ON CLARIFICATION,
Agricultural Research Service, Bushland, Tex. Soil and Water Conservation Research Div.
Oliver R. Lehman, and Victor L. Hauser.
Water Resources Research, Vol 6, No 5, p 1420-1423, October 1970. 4 p, 2 tab, 5 ref.

Descriptors: *Playas, *Water quality, *Water resources development, *Artificial recharge, Water conservation, Turbidity, Nutrients, Irrigation water, Water sources, Water analysis, Water treatment.
Identifiers: Water clarification.

An estimated 2 to 5 million acre-feet of runoff water accumulates annually in playas on the semiarid southern high plains; however, development of this large potential water source has been impeded by lack of water quality data. Most of the water is lost by evaporation, and timely utilization is essential. Therefore, a particular need exists for quality data on freshly impounded water. Water from five playas was sampled and analyzed at intervals for 24 days following runoff from a single storm. Chemical analyses showed playa waters were excellent for irrigation; however, adequate economical clarification is probably needed for such projects as direct aquifer injection. With aging, less synthetic cationic polyelectrolyte and more alum was required for water clarification. Initially low nitrate and chemical oxygen demand values decreased with time. (Knapp-USGS)
W71-00578

SILICA IN THE GROUNDWATERS OF PETROLEUM RESERVOIRS IN THE PRE-CARPATHIAN DOWNWARP,
Akademiya Nauk URSR, Lvov. Inst. of Geology and Geochemistry of Fossil Fuels.
V. M. Shchepak, and V. I. Migovich.
Translated from Geokhimiya, No 11, p 1397-1404, 1969. Geochemistry International, Vol 6, No 6, p 1093-1100, 1969. 8 p, 7 tab, 7 ref.

Descriptors: *Water chemistry, *Silica, *Oil fields, *Geochemistry, *Exploration, Surveys, Oil industry, Subsurface investigations, Chemical reactions, Aquifers.
Identifiers: *Geochemical prospecting, *USSR, Carpathian downwarp.

Silica content was investigated in highly mineralized connate waters related and unrelated to the petroleum deposits of the Pre-Carpathian downwarp. It was found that petroleum accumulations are surrounded by waters with relatively low silica content; values are nearly all less than 4 mg/liter. This fact may be used as an additional hydrochemical indicator in the search for gas and petroleum-bearing structures in Pre-Carpathia and other petroliferous regions. (Knapp-USGS)
W71-00612

A POLAROGRAPHIC TECHNIQUE FOR THE MEASUREMENT OF DISSOLVED SULPHIDE IN WATERLOGGED SOILS,
University Coll. of South Wales and Monmouthshire, Cardiff. Dept. of Botany.
W. Armstrong.
Journal of Soil Science, Vol 18, No 2, p 282-288, September 1967. 7 p, 3 fig, 10 ref.

Descriptors: *Polarographic analysis, *Sulfides, *Saturated soils, Electrodes, Temperature.
Identifiers: Dropping mercury electrode, Saturated calomel electrode, Agar-KCl bridge.

Soil solution is expressed from cores removed from the soil in a Hiller-type borer, and transferred to tubes containing pyrogallol and NaOH. A current-voltage curve for each sample is then obtained using the dropping mercury electrode in conjunction with a saturated calomel electrode. The current in the plateau region of a curve is proportional to the sulfide concentration, and after volume and temperature corrections the sulfide concentration

in a sample can be read from a previously prepared calibration curve. The possibility of sulfide loss from the samples before analysis has been found to be slight. Details of construction, and calibration of the dropping mercury electrode using standard Na2S solutions, are included in the description of the technique and apparatus. The inclusion of such minor modifications as (a) the insertion of a condenser across the microammeter terminals to dampen the large current oscillations produced by the dropping mercury electrode, and (b) the inclusion of a switch to allow reversal of polarity at the microammeter, enabled a circuit of the type currently used for soil oxygen diffusion measurements to be used also for sulfide estimation. (Woodard-USGS)
W71-00616

FACTORS AFFECTING THE TRANSFER OF MATERIALS BETWEEN WATER AND SEDIMENTS,
Wisconsin Univ., Madison. Water Resources Center.
G. Fred Lee.
Available from NTIS as PB-195 220, $3.00 in paper copy, $0.95 in microfiche. Wisconsin Univ, Madison, Water Resources Center, Eutrophication Information Program, Literature Review No 1, 1970. 50 p, 120 ref. OWRR Project W-117 (1614) (1).

Descriptors: *Sediments, *Sedimentology, Sediment-water interfaces, Particle size, Lake soils, Lakes, Phosphorus, Chemical properties, Eutrophication, Nitrogen, Hydrodynamics, Oxidation-reduction potential, Sorption.
Identifiers: *Phosphate buffer, *Phosphate levels, Biological factors, Acid-base, Precipitation-solubilization, Complexation, Exchange reactions.

A general description of the possible factors involved in various kinds of exchange reactions between waters and sediments is presented. Basically, the exchange reactions have been broken down into physical control, where hydrodynamics plays the important role in determining the rate of exchange, and biological and chemical control where the processes bringing the material onto or from the surface of the solid are the major function. Knowledge of exchange reactions and the factors influencing them appears to be extremely meager. In fact, it is almost impossible to make any predictions about the magnitude or rate of exchange for any species in a system that has not been investigated. Hopefully, current research in this area will help to eliminate this deficiency in knowledge within a few years. (Lee-Wisconsin)
W71-00618

ANALYSIS OF TIME-VARIANT BEHAVIOR OF WATER CHEMISTRY,
Nevada Univ., Reno. Desert Research Inst.
John V. A. Sharp.
Available from NTIS as PB-195 305, $3.00 in paper copy, $0.95 in microfiche. Preprint No 71, Paper H-23, presented at 51st Annual Meeting of American Geophysical Union, Washington, DC, April 21, 1970. 10 p, 4 fig, 3 ref. OWRR Projects A-017-NEV (3) and A-024-NEV (3).

Descriptors: *Water quality, *Time series analysis, *Sampling, *Water chemistry, Frequency analysis, Statistical methods, Stochastic processes, Streamflow, Water pollution sources, Seasonal, Data collections.
Identifiers: Water quality variation.

Time-variant behavior of water chemistry is controlled by internal factors of a hydrologic system and by external stimuli. Periodic sampling of water provides data to compute this variation. The observed time variation can be modeled as a discontinuous time series, composed of time-systematic and stochastic components. The stochastic component is a residual attributed to random fluctuations in the parent water chemistry and in sampling analysis. Nonparametric tests confirm and amplify results of serial correlation. Tests are selected for their discrimination against specific time-variant alternatives to constant behavior. Several examples demonstrate the interplay between serial correlation and nonparametric techniques and some of the interpretative difficulties met in practice. (See also W71-00630). (Knapp-USGS)
W71-00629

TIME-DEPENDENT BEHAVIOR OF WATER CHEMISTRY IN HYDROLOGIC SYSTEMS,
Nevada Univ., Reno. Desert Research Inst.
John V. A. Sharp.
Available from NTIS as PB-195 306, $3.00 in paper copy, $0.95 in microfiche. Preprint No 68, Desert Research Institute, Nevada University, May 1969. 11 p, 9 fig. OWRR Project No A-017-NEV (2), and A-024-NEV (2).

Descriptors: *Water quality, *Variability, Sampling, Fluctuation, Statistics, Data collections, Hydrologic data, Water chemistry, Water pollution sources, Path of pollutants.
Identifiers: Water quality variation.

Water chemistry at a pount in a hydrologic system varies continuously with time. In order to characterize this series it is necessary to monitor the water chemistry, either on a discontinuous basis, for example, discrete monthly sampling, or on a continuous basis. A general model of the resulting time-dependent behavior is the sum of two components. One component is described deterministically by a mathematical function of time which is the basis for the behavioral classification. The second component is unsystematic, fluctuating randomly. This 'noise' is an unresolved mixture of random variation in both chemistry of the water and sampling/analysis procedures. In practice, the unsystematic omponent is the residual from the systematic and describes some probability distribution. The unsystematic component is regarded as superimposed on the systematic component and to a varying degree obscures it. Combinations occur of trend, cyclical, and oscillatory behavior. Some examples of time-dependent behavior as exhibited by water points in Nevada and eastern California are discussed. (See also W71-00629). (Knapp-USGS)
W71-00630

ADSORPTION OF ORGANIC COMPOUNDS ONTO SOLIDS FROM AQUEOUS SOLUTIONS,
Virginia Polytechnic Inst., Blacksburg.
For primary bibliographic entry see Field 01B.
W71-00633

OXYGEN PRODUCTION IN EXPERIMENTAL CHANNELS,
Michigan Univ., Ann Arbor. Dept. of Environmental Health.
P. G. Meier, J. J. Gannon, and M. E. Bender.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 2, 1970. Preprint. 17 p, 15 fig, 4 tab, 20 ref.

Descriptors: *Oxygen, *Streams, *Algae, Velocity, Light, Biomass, Respiration, Photosynthesis, Dissolved oxygen, Reservoirs, Aeration, Plant growth, Chlorophyll, Phytoplankton, Periphyton, Model studies, Hydrologic models, Simulation.
Identifiers: Oxygen deficit, Oxygen production.

Two levels of each variable--velocity, light, biomass, and oxygen deficit--were incorporated into a factorial design to determine their effects on algal (attached and free-floating) oxygen production and respiration in flowing systems. The dissolved oxygen concentration was depressed in river water, stored in reservoirs and passed through channels. Increase in dissolved oxygen concentration was used to calculate photosynthetic contribution above physical reaeration. Data indicated that effects of light and growth and their interactions were highly significant while no significant effects of high and low oxygen deficit and high and low current velocity were observed. Flow was the only variable in later experiments and its influence on biomass, chlorophyll concentration, respiration, and oxygen production was investigated. Results indicated that their amounts were as great if no greater in the low as in the higher velocities, although more time was required for biological equilibrium. Effect of light on oxygen production was under observation. In velocities .25 through 1.4 fps, oxygen production and biomass accrual of attached algae vary insignificantly. A total oxygen asset of approximately 2 milligrams dissolved oxygen of milligram of chlorophyll a per day was calculated. (Jones-Wisconsin)
W71-00660

PHOTOSYNTHESIS AND ZONATION OF FRESHWATER MACROPHYTES. I. DEPTH DISTRIBUTION AND SHADE TOLERANCE,
Saint Andrews Univ. (Scotland). Dept. of Botany.
D. H. N. Spence, and Jean Chrystal.
New Phytologist, Vol 69, No 1, p 205-215, 1970. 5 fig, 5 tab, 17 ref.

Descriptors: *Photosynthesis, *Fresh water, Depth, Lakes, Oxygen, Productivity, Light intensity, Chlorophyll, Swamps, Ecosystems, Laboratory tests.
Identifiers: *Macrophytes, Potamogeton praelongus, Potamogeton obtusifolius, Zonation, Potamogeton natans, Potamogeton polygonifolius, Potamogeton z Zizii, Myriophyllum spicatum, Myriophyllum gramineus.

The effects of varying light intensity upon rates of photosynthesis by certain species of submerged higher plants are described. The mean, range, and standard deviation are given of the depths of water above the soil surface in which a number of Potamogeton species occur in Scottish lochs. Sun leaves of these species were produced in unscreened containers in a glasshouse and their rates of net oxygen production were measured at irradiances of from 1.34 to 7.08 calories/square centimeter per hour in a Warburg apparatus, using Warburg buffer No 11 as bathing solution. Using only leaves of species of which the rates appeared to be unaffected by buffer solution during the experiments, it was shown that the shade tolerance of these leaves is correlated with the natural depth distribution of the species. This valid contrast in inherent photosynthesis response between some deep water species (for example, P praeongus, P obtusifolius) and some shallow water species (P polygonifolius) indicates that light may be as important as substrate or competition in controlling the zonation of freshwater macrophytes. (Jones-Wisconsin)
W71-00670

CHANGE OF C/N RATIO DURING THE COURSE OF DEVELOPMENT OF SPHAEROMA SERRATUM (CRUSTACEAN ISOPODE) (IN FRENCH),
Centre d'Oceanographie, Marseille (France). Station Marine d'Endoume.
Pierre Kerambrun.
Comptes Rendus Academie des Sciences, Paris, Vol 270, No 4, Serie D, p 635-637, 1970. 2 fig, 3 ref.

Descriptors: *Isopods, *Crustaceans, Carbon, Nitrogen, Marine animals, Benthic fauna.
Identifiers: *Carbon:nitrogen ratio, Sphaeroma serratum, Sexual activity, T-test, Gulf of Marseille.

Determination of carbon, hydrogen, and nitrogen in tissues of Sphaeroma serratum in different stages of development revealed that carbon/nitrogen ratio fluctuates with the weight of organisms. The carbon/nitrogen ratio of young isopodes is about 6.3; it increases to the maximum of 6.8 when the organisms attain a dry weight of approximately 15 milligrams. Further growth induces a decrease of the carbon/nitrogen ratio which in specimens exceeding 30 milligrams drops to the original value of 6.3. This decrease, coinciding with the period of max-

imum sexual activity, is largely due to the augmented content of nitrogen. (Wilde-Wisconsin)
W71-00680

EXPERIMENTAL STUDIES OF THE TURNOVER OF PHOSPHATE IN MARINE ENVIRONMENTS,
Georgia Univ., Athens. Dept. of Zoology; and Georgia Univ., Sapelo Island. Marine Inst.
Lawrence R. Pomeroy.
Radioecology, Proceedings of the 1st National Symposium on Radioecology, Colorado State University, Fort Collins, September 10-15, 1961. New York, Reinhold, 1963. p 163-166, 5 fig, 1 tab, 12 ref.

Descriptors: *Phosphates, *Sea water, *Turnovers, Phosphorus radioisotopes, Tracers, Photosynthesis, Estuarine environment, Bacteria, Cycles, Seasonal, Radioactivity, Plankton, Detritus, Suspended load, Georgia, Light, Salt marshes, Brackish water.
Identifiers: *Short-term phosphate turnover, Antibiotics, Methylene blue, Gulf Stream, Inorganic solids, Phosphorylation, Doboy Sound (Ga), Sapelo Island (Ga), Kryptoperidinium, Nostocaceae, Altamaha River (Ga).

An understanding of the phosphorus cycle requires a critical examination of the short-term events upon which seasonal cycles are balanced. Short-term events may be physical or biological; they may be sorption reactions or may involve active uptake and release of phosphate by living organisms. An attempt is made to separate experimentally the physical from the biological processes, to evaluate their relative importance in the short-term turnover of phosphate in natural waters, and to make some preliminary attempts to identify the processes involved. The addition of methylene blue and cyanide to natural waters blocks the short-term turnover of phosphate between water and suspended solids; the turnover is therefore believed to involve biological processes, probably phosphorylation. In darkness the turnover rate of phosphate is sometimes reduced, suggesting that photosynthetic organisms can play a significant role in phosphate turnover, perhaps in proportion to their abundance. Addition of antibiotics to sea water and estuarine water may inhibit the release of phosphates from suspended solids, but often has little effect. Therefore, the role of bacteria in phosphate turnover may vary greatly and may depend on the size or character of the bacterial flora. (Jones-Wisconsin)
W71-00683

PROBLEMS IN THE CLIMATIC GEOMORPHOLOGY OF ARID LANDS,
New South Wales Univ., Kensington (Australia). School of Geography.
For primary bibliographic entry see Field 02J.
W71-00700

ION-ION AND ION-MOLECULE INTERACTIONS IN AQUEOUS SALT SOLUTIONS,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 01B.
W71-00705

A PREDATOR-PREY RELATIONSHIP. SEA STARS-BIVALVES. THE CHEMICAL BASIS OF THE RESPONSE OF ASTERIAS VULGARIS TO CRASSOSTREA VIRGINICA. A BIOASSAY, ITS APPLICATIONS AND THE PARTIAL PURIFICATION OF AN ACTIVE EXTRACT,
Woods Hole Oceanographic Institution, Mass.
For primary bibliographic entry see Field 05C.
W71-00787

OCEANOGRAPHY: A BIBLIOGRAPHY OF SELECTED ACTIVATION ANALYSIS LITERATURE.
National Bureau of Standards, Washington, D.C., Analytical Chemistry Div.
For primary bibliographic entry see Field 10.
W71-00795

POLLUTION ANALYSIS: A BIBLIOGRAPHY OF THE LITERATURE OF ACTIVATION ANALYSIS.
National Bureau of Standards, Washington, D.C. Analytical Chemistry Div.
For primary bibliographic entry see Field 10.
W71-00796

CONCENTRATIONS OF PARTICULATE IRON IN ATLANTIC OPEN-OCEAN WATER,
Rhode Island Univ., Kingston. Narragansett Marine Lab.
Peter R. Betzer, and Michael E. Q. Pilson.
Journal of Marine Research, Vol 28, No 2, p 251-267, May 15, 1970. 17 p, 2 fig, 4 tab, 18 ref, append. ONR Contract No 396 (08).

Descriptors: *Suspended load, *Iron, *Sea water, *Atlantic Ocean, Spectrophotometry, Sampling, Depth, Methodology, Geochemistry, Biochemistry, Diatoms, Phytoplankton, Reviews.
Identifiers: *Particulate iron concentrations, Caribbean Sea, Atomic absorption spectroscopy.

Measurements of particulate iron concentrations by atomic absorption spectroscopy have been carried out on samples from the western Atlantic Ocean and the Caribbean Sea. The average of 184 iron determinations on shallow open-ocean water (o-300 m) was 0.177 micrograms per liter; the average of 112 determinations on deep water (500-7535 m) was 0.255 micrograms per liter. These averages are lower than previous estimates by an order of magnitude or more. Spectrophotometric and atomic-absorption analyses carried out on a set of duplicate samples from the surface water of the Puerto Rican Trench indicate that the method of analysis is not the reason for the large discrepancy observed in the concentrations of particulate iron. Included in the report are related tables of data, and a map of sample collection sites. (Woodard-USGS)
W71-00867

STUDY AND INTERPRETATION OF THE CHEMICAL CHARACTERISTICS OF NATURAL WATER,
Geological Survey, Washington, D.C.
John D. Hem.
For sale by the Superintendent of Documents, U S Government Printing Office, Wash, D C, 20402 - Price $2.25 per copy. Geological Survey Water-Supply Paper 1473, 1970 (Second Edition). 363 p, 51 fig, 2 plate, 29 tab, 416 ref.

Descriptors: *Water quality, *Water chemistry, *Water analysis, *Sampling, Water structure, Radioactivity, Solutes, Aqueous solutions, Chemical reactions, Thermodynamics, Water pollution sources, Pollutant identification, Biochemistry, Weathering, Leaching, Laboratory tests, Analytical techniques, Hydrologic cycle, Chemistry of precipitation, Geochemistry.
Identifiers: Chemistry of natural water (Textbook).

This textbook has two principal objectives: (1) to outline the principles and processes, chemical and environmental, which shape and control the chemical composition of natural water, and (2) to discuss the chemistry of individual constituents and methods of data interpretation, and to present associated bibliographic references. The chemical composition of rocks, the ocean, and the atmosphere are significant in evaluating sources of solutes in natural fresh water. Fundamental data used in the determination of water quality are obtained by the chemical analysis of water samples in the laboratory or onsite sensing of chemical properties in the field. More than 60 constituents and properties are frequently included in water analysis. Graphing of analyses or of groups of analyses aids in showing chemical relationships among waters, probable sources of solutes, areal water-quality regimen, and water-resources evaluation. About 75 water analyses selected from the literature are tabulated to illustrate the relationships described. Relationships of water composition to source rock type are illustrated by graphs of some of the tabulated analyses. Water-quality standards for domestic, agricultural, and industrial use have been published by various agencies. Irrigation project requirements for water quality are particularly intricate. (Knapp-USGS)
W71-00879

THE pH OF WATER IN FLORIDA STREAMS AND CANALS,
Geological Survey, Tallahassee, Fla.
Matthew I. Kaufman.
Florida Bureau of Geology Map Series 37, 1970. 1 sheet, 6 fig, 1 map, 2 tab, 10 ref.

Descriptors: *Hydrogen ion concentration, *Surface waters, *Florida, Maps, Acidity, Streams, Canals, Discharge (Water), Streamflow, Bicarbonates, Color, Conductivity.
Identifiers: Relationship curves, Chemical characteristics.

This report presents in a succinct and usable form information on the pH of streams and canals throughout Florida as an aid to water managers, users, and planners. The variations in pH are related to environmental causes. The minimum pH of water and the range through which the pH of stream waters fluctuate in the various geographic areas is significant with respect to industrial, municipal, and recreational uses, aquatic productivity, the State of Florida's water quality such as culverts, in addition to governing the toxicity, mobility, and solubility of many compounds. (Woodard-USGS)
W71-00883

RELATION OF SOIL HYDRAULIC CONDUCTIVITY TO EXCHANGEABLE CATIONS AND SALINITY,
New Mexico State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 02G.
W71-00895

CONTINUOUS CATALYTIC DECOMPOSITION OF METHANE,
Battelle Memorial Institute, Columbus, Ohio.
For primary bibliographic entry see Field 05D.
W71-00909

CHARACTERIZATION OF BOTTOM SEDIMENTS: CATION EXCHANGE CAPACITY AND EXCHANGEABLE CATION STATUS,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Soils and Crops.
Stephen J. Toth, and Arthur N. Ott.
Environmental Science and Technology, Vol 4, No 11, p 935-939, November 1970. 5 p, 4 tab, 11 ref.

Descriptors: *Bottom sediments, *Ion exchange, *Cation exchange, *Clays, Iron, Manganese, Organic soils, Organic matter, Oxidation-reduction potential, Soil chemistry, Sampling, Rivers, Estuaries, Lakes, Reservoirs, Water chemistry.
Identifiers: Cation exchange capacity.

Two parameters, cation exchange capacity (CEC) and exchangeable cation status (ECS), were used to characterize bottom sediments collected from rivers, bays, and freshwater impoundments. It was necessary to investigate the effect of drying on CEC and exchangeable Fe and Mn to arrive at satisfactory modifications of soil techniques used for these parameters. Wide variations were obtained in CEC and ECS values for the sediments. CEC and ECS values may be utilized for determining saltwater intrusions and pollution effects. (Knapp-USGS)
W71-01059

TRITIUM IN SURFACE WATER HYDROLOGY-EXPERIMENTAL DETERMINATION OF THE RUNOFF COEFFICIENT (FRENCH),
Bureau of Geological and Mining Research, Orleans (France).
For primary bibliographic entry see Field 02A.
W71-01060

2L. Estuaries

BIOLOGICAL ZONATION RELATED TO GROUNDWATER DISCHARGE ALONG THE SHORE OF BISCAYNE BAY, MIAMI, FLORIDA,
Geological Survey, Miami, Fla. Water Resources Div.
F. A. Kohout, and M. C. Kolipinski.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, DC, p 488-499, 1967. 12 p, 16 fig, 1 tab, 27 ref.

Descriptors: *Discharge (Water), *Springs, *Salinity, *Ecological distribution, *Saline water-freshwater interfaces, *Florida, Barriers, Biological communities, Distribution, Spatial distribution, Groundwater movement, Water levels, Saline water intrusion.
Identifiers: Biscayne Bay (Fla).

Discharge of fresh groundwater through the littoral bottom sediments of a bay or shallow sea may produce a biological zonation. The overriding function appears to be that of dilution of the interstitial water and nearshore sea water. Zonation should exist along any shoreline where a fresh groundwater reservoir is hydraulically connected to a saltwater body through permeable bottom sediments. The hydrological factors leading to zonation are demonstrated by the resulting gradation of flora and fauna at a site near Miami, Florida. The coral, Siderastrea sideria, dropped out landward at about 700 feet from shore, where the salinity ranged from 21 to 30 ppt, and the loggerhead sponge, Sphecospongia vesparia, dropped out at 400 feet from shore where the salinity ranged from 13 to 28 ppt. The gastropods, Turbo castaneus and Columbella rusticoides dropped out in the shoreward region of freshened bay water. In contrast, the brackish forms, such as Neritina virginea and Taphromysis bowmani, decrease seaward. These distributions focus at a distance of about 300 feet from shore, which is also the distance at which the main part of the groundwater discharge terminates. (Knapp-USGS)
W71-00615

NUTRIENT AND PLANKTON ECOLOGY OF THE COLUMBIA RIVER ESTUARY,
Oregon State Univ., Corvallis. Dept. of Oceanography.
Lois Haertel, Charles Osterberg, Herbert Curl, Jr, and P. Kilho Park.
Ecology, Vol 50, No 6, p 962-978, 1969. 8 fig, 8 tab, 38 ref.

Descriptors: *Nutrients, *Plankton, *Ecology, *Estuaries, *Columbia River, Brackish water, Saline water, Nitrates, Phosphates, River flow, Silicates, Solar radiation, Temperature, Hydrography, Scenedesmus, Euglenophyta, Pyrrophyta, Light intensity, Rotifers, Copepods, Daphnia, Aquatic microorganisms, Oxygen, Regression analysis, Zooplankton, Phytoplankton.

Monthly samples of nutrients, phytoplankton, and zooplankton were taken from Columbia River estuary during 16 months to determine distribution with season and salinity, and interrelationships between plankton and nutrients. Nitrate and phosphate levels in river water entering the estuary are high in winter and are depleted in summer; silicate levels are high in the river water at all season. During summer upwelling season, nitrate and phosphate levels in the entering ocean water are high. Although nutrient levels in the estuary generally show linear relationship with salinity, nitrate and phosphate tend to be enriched in bottom waters of the central part of the estuary. Estuarine phytoplankton is primarily composed of freshwater species, probably representing a downstream extension of the river flora. Linear regression analysis indicates a strong correlation between phytoplankton abundance and solar radiation. Estuary zooplankton is composed of fresh water, oligohaline, and polyhaline forms. Eurytemore affinis (an oligohaline), the major zooplankter, reaches population densities of 100,000/cubic meter or more. Regression analysis indicates strong correlation between abundance of freshwater zooplankton and river temperature and close correlation between phosphate levels and Eurytemore abundance, exhibiting strong potential for zooplankton regeneration of phosphate necessary for phytoplankton growth. (Jones-Wisconsin)
W71-00666

ON THE STATISTICAL APPROACH TO ECOLOGICAL STUDIES OF MARINE BACTERIA (IN RUSSIAN),
Gidrometeorologicheskii Institut Odessa (USSR).
A. V. Tsyban, and V. A. Shaidman.
Doklady Academy of Sciences of USSR, Vol 188, No 5, p 1159-1162, 1969. 1 fig, 5 ref.

Descriptors: *Statistical methods, *Analysis, *Mathematical studies, *Marine bacteria, Temperature, Salinity, Distribution, Population.
Identifiers: *Prismatic ecograms, Black Sea, Thermo-halidic gradients.

The statistical method of prismatic ecograms is reported in application to the distribution of sea-inhabiting bacteria. The analysis is based on the two easily determinable parameters--temperature and salinity of water. The probability of 90% is accepted as the minimum significance for the frequency of occurrence of a species in relation to the thermo-halidic gradient. The study embraced the following heterotrophic bacteria of the Black Sea: Bacterium agile, B Liquifaciens, B galophilum, Chromobacterium aurantiacum, Pseudomonas sinuousa, Micrococcus aurantiacus, Bacillus solidus, B album, Micrococcus cinnabareus, B subtilis, M citreus, M candidus. The method is applicable for an appraisal of populations in relation to other ecological factors in any part of the biosphere. (Wilde-Wisconsin)
W71-00672

CHANGE OF C/N RATIO DURING THE COURSE OF DEVELOPMENT OF SPHAEROMA SERRATUM (CRUSTACEAN ISOPODE) (IN FRENCH),
Centre d'Oceanographie, Marseille (France). Station Marine d'Endoume.
For primary bibliographic entry see Field 02K.
W71-00680

THE EFFECT OF SALINITY ON THE REMOVAL OF SOME ALIPHATIC KETONES,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 05C.
W71-00789

SAND INVENTORY PROGRAM. A STUDY OF NEW JERSEY AND NORTHERN NEW ENGLAND COASTAL WATERS,
Army Coastal Engineering Research Center, Washington, D.C.
David B. Duane.
Available from the NTIS as AD 703 583, $3.00 in paper copy, $0.95 in microfiche. Shore and Beach, October 1969, 5 p.
Identifiers: *Seacoast, Protection, *Sand, Beaches, Deposits, Stabilization, Gravel, Reflection, Maine, New Jersey, Pipes, Connecticut, Massachusetts, Coastal engineering, *Offshore sand deposits, Cape May (New Jersey), Beach stabilization, Shore protection, Pipelines.

CERC continues to seek and delineate offshore deposits of sand for beach restoration and stabilization. This Sand Inventory Program, in its exploration phase, uses seismic reflection profiles of the bottom and subbottom and also coring of the bottom. Laboratory analyses of the field data define the location, characteristics, extent, and quantity of the sand deposits that can be used for shore protection. CERC has conducted detailed exploration surveys off New Jersey, east Florida, New England, Long Island, and Norfolk, Virginia. This work covers 7,3000 miles of geophysical surveys and includes 1,037 cores and more than 5,000 sand-sample analyses. Within several miles of the shore and in water shoaler than 100 feet, the surveys revealed more than 4 million cubic yards of sand suitable for beach nourishment. In 1966, off New Jersey, the Corps of Engineers proved the practicability of recovering these sand deposits from the bottom and putting them on eroded beaches at a competitive cost. The work was accomplished by a large hopper dredge with a pump-out capability. More recently, a Federal beach near Los Angeles was artifically replenished by recovering an offshore deposit with a pipeline dredge.
W71-00791

SEDIMENT DISTRIBUTION AND HYDRODYNAMICS SACO RIVER AND SCARBORO ESTUARIES, MAINE,
Massachusetts Univ., Amherst. Coastal Research Group.
For primary bibliographic entry see Field 02J.
W71-00797

HYDROGRAPHY AND HOLOCENE SEDIMENTATION OF THE MERRIMACK RIVER ESTUARY, MASSACHUSETTS,
Massachusetts Univ., Amherst. Coastal Research Group.
Allan D. Hartwell.
Available from the NTIS as AD-709 144, $3.00 in paper copy, $0.95 in microfiche. June 1970, 181 p. Contribution No 5-CRG. NR 388-084.
Identifiers: *Hydrology, Massachusetts, *Rivers, Sedimentation, Geologic age determination, Environment, Sand, Particle size, Merrimack River, *Estuarine hydrography, *Holocene sedimentation.

The Merrimack River estuary, situated on glaciated terrain along the coast of northeastern Massachusetts, is representative of the Type B estuary of Pritchard (1955). A sharp, slightly tilted boundary between salt water to the north and fresh water to the south develops during periods of normal and high runoffs. At low runoff the stratification disappears. The distribution of bottom sediments is closely related to the hydraulic circulation pattern, tidal current velocities, bottom topography, and sediment source areas. Three types of sand are present in the estuary. A yellow-orange feldspathic suite occupies the main channel. A gray feldspathic suite underlines the marshes of the lower estuary. A third sand type, which is predominantly quartz (86%) with subequal amounts of gray and yellow-orange feldspar (5%), is common in the central part of the main channel and in some tidal channels. The stratigraphy and geometry of the deposits of the fringing salt marshes document a gradual rise in sea level and infilling of an original open bay environment behind the barrier islands accompanying marine transgression since later Pleistocene.
W71-00798

HEAVY MINERAL INVESTIGATION OF CARMEL BAY BEACH SANDS,
Naval Postgraduate School, Monterey, Calif.
Paul Adolph Griffin.
Available from NTIS as AD 704 078, $3.00 in paper copy, $0.95 in microfiche. October 1969, 48 p. MS Thesis.
Identifiers: *Minerals, California, *Beaches, California, *Minerals, Analysis, Sand, Transport properties, Sampling, Petrography, Garnet,

Geologic age determination, Seascoast, Theses, Carmel Bay, California, Littoral drift, *Heavy mineral analysis, Schists, Augites.

The investigation was conducted in order to identify the heavy minerals of the beach sands of Carmel Bay, and to analyze the distribution of these minerals. Carmel Bay offers the opportunity to study heavy mineral assemblages in a small isolated bay, internally divided by a submarine canyon, containing smaller pocket beaches influenced by several geological formations, and two fresh water streams. Correlation of the heavy mineral assemblage of each sample with the sample location clearly indicate that the beach sands can be divided into two principal mineral suites that are derivatives of the geological formations in immediate contact with the individual pocket beaches. The unique nature of each suite is preserved by natural obstructions that limit the influence of littoral drift and restrict the exchange of the beach sands.
W71-00809

LAND AGAINST THE SEA.
Army Coastal Engineering Research Center, Washington, D.C.

Available from NTIS as AD-453 227, $3.00 in paper copy, $0.95 in microfiche. May 1964, 43 p. Miscellaneous Paper No. 4-64.
Identifiers: *Beaches, Erosion, *Seacoast, Protection, Sand, Deltas, Bulkheads, Breakwaters, Hydrology, Tides, Law, Storms, Wind, Ocean waves, Ocean currents, Reinforcing materials, *Beach erosion, *Shore protection.

Described in non-technical language are the origin and nature of our sea coasts, the forces of which those coasts are exposed, the behavior of the shores under exposure to those forces, the effects thereon of development by man, and the characteristics of methods for the protection and improvement of the shore. Also described are the roles of the local, state, and federal governments in providing for sound development, protection and improvement of the shore, and discussion of the need of long-range planning for preservation of our coastal resources.
W71-00824

SEDIMENT BALANCE OF CLYDE ESTUARY,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
George Fleming.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY11, Paper 7676, p 2219-2230, November 1970. 12 p, 7 fig, 3 tab, 8 ref.

Descriptors: *Estuaries, *Sedimentation, *Sediment yield, Dredging, Flood control, Floods, Sediment transport, Suspended load, Navigation, Data collections, Channel improvement.
Identifiers: Sediment balance.

The development of the Clyde Estuary in Scotland is considered in relation to its sedimentation. The historical facts relating to the changes in regime of the Estuary are listed to the present (1969) conditions. The results of 3 yr of detailed research into the sediment transport conditions of the major rivers draining into the Estuary include comparison of annual sediment loads computed by two different methods, the particle size of the transported sediment, and typical graphs of the weekly suspended sediment loads transported by the rivers Clyde, White Cart, and Kelvin. The historical development of the Clyde has affected the balance between the influences of tides, streamflow, cross-section geometry and sediment load on the deposition processes in the estuary. All the sediment entering the estuary deposits in the upper reaches. Reasonable agreement exists between the amount of sediment entering the estuary and the amount dredged. The contribution of sewage discharges and spillage to the total sediment load is significant, although their influence is of more major importance as pollutants, which reduce the dissolved oxygen levels and increase the BOD within the estuary. Cessation in present dredging operations could result in the occurrence of floods once more overtopping the banks of the Clyde adjacent to Glasgow. (Knapp-USGS)
W71-00844

BLACK SEA: RECENT SEDIMENTARY HISTORY,
Woods Hole Oceanographic Inst., Woods Hole, Mass.
For primary bibliographic entry see Field 02J.
W71-00855

CONCENTRATIONS OF PARTICULATE IRON IN ATLANTIC OPEN-OCEAN WATER,
Rhode Island Univ., Kingston. Narragansett Marine Lab.
For primary bibliographic entry see Field 02K.
W71-00867

CIRCULATION IN THE AMAZON RIVER ESTUARY AND ADJACENT ATLANTIC OCEAN,
Northwestern Univ., Evanston, Ill. Dept. of Geological Sciences.
Ronald J. Gibbs.
Journal of Marine Research, Vol 28, No 2, p 113-123, May 15, 1970. 11 p, 6 fig, 3 tab, 12 ref. ONR Contract N00014-67-A-0111-0006.

Descriptors: *Saline water-freshwater interfaces, *Atlantic Ocean, *Estuaries, Ocean circulation, Ocean currents, Winds, Riverflow, Discharge (Water), Tides, Salinity, Mixing, Sea water, Freshwater, Stratification, Sampling.
Identifiers: *Amazon estuary (South America), *Isohalines, Salinometer.

A preliminary survey of the water circulation in the Amazon estuary and adjacent ocean was conducted during both low-river and high-river discharge. Results indicate that, due to the river's large discharge, no salt-water wedge (35 parts per thousand) enters the Amazon estuary during either low-river or high-river discharge. The zone of nearly vertical isohalines in the ocean near the river mouth represents an area of turbulent mixing. As the vertical mixing decreases seaward, a vertical stratification develops from about 60 km offshore during low-river discharge and from about 80 km offshore during high-river discharge. This stratification persists seaward across the continental shelf for 185 km during low-river discharge and for about 230 km during high-river discharge. During low-river discharge, an isolated freshwater lens was observed far off the French Guiana Coast. Related maps, graphs, and tables of data are included. (Woodard-USGS)
W71-00868

THE INFLUENCE OF DEPOSIT-FEEDING ORGANISMS ON SEDIMENT STABILITY AND COMMUNITY TROPHIC STRUCTURE,
Yale Univ., New Haven, Conn. Dept. of Geology and Geophysics; and Marine Biological Lab., Woods Hole, Mass.
Donald C. Rhoads, and David K. Young.
Journal of Marine Research, Vol 28, No 2, p 150-178, May 15, 1970. 29 p, 19 fig, 44 ref. NSF Grants GB 7181, GB 4509, and GB 7387.

Descriptors: *Sedimentation, *Benthos, *Foods, *Trophic level, *Bays, Sediment distribution, Suspended sediment, Mud, Sampling, Silts, Organic matter, Currents (Water), Photography, Laboratory tests.
Identifiers: *Deposit-feeding organisms, Sediment properties, Buzzards Bay (Massachusetts).

Deposit-feeding and suspendion-feeding benthos in Buzzards Bay, Massachusetts, show marked spatial separation; suspension feeders are largely confined to sandy or firm mud bottoms while deposit feeders attain high densities on soft muddy substrata. Food source and bottom stability have been investigated as potential factors effecting this trophic-group separation. Observations were made at 11 stations along two widely separated transects over bottoms ranging in texture from silt to fine and medium sand. Water depths at these stations ranged from 3 m to 20 m. SCUBA divers made many of the field observations and collected most of the samples. This study included sampling of benthic macofauna, taking bottom photographs, analyzing sedimentary structures, texture, organic content and water content of the sediments, and measuring both water currents and suspended sediment above the bottom. Laboratory experiments were also carried out to determine differential resuspension between burrowed and unburrowed muds. (Woodard-USGS)
W71-00869

HOLOCENE SEDIMENTS OF THE PARKER RIVER ESTUARY, MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Geology.
Joan M. DaBoll.
Available from NTIS as AD-694493, $3.00 in paper copy, $0.95 in microfiche. Massachusetts University Department of Geology, Coastal Research Group Contribution No 3-CRG, June 1969. 138 p, 42 fig, 1 plate, 1 tab, 17 ref. Contract No Nonr N00014-67-A-0230-0001.

Descriptors: *Estuaries, *Massachusetts, *Sedimentation, Sediment transport, Sands, Sedimentary structures, Tides, Tidal effects, Currents (Water), Water circulation, Streamflow, Sand waves, Ripple marks.
Identifiers: Parker River Estuary (Mass).

The Parker River estuary is situated in glaciated terrain behind Plum Island, Massachusetts. It contains a meandering main channel, large point bars on the meander loops, and a complex flood-tidal delta system. The estuary is predominantly horizontally and vertically mixed, with a tendency toward slight horizontal salinity stratification. Ebb currents are stronger than flood currents in the main channel, whereas flood currents are stronger than ebb currents in the flood bifurcations off the main channel and over the tidal flats. Large bedforms (sand waves) are abundant in the sandy areas, and reflect the current pattern to a high degree. In general, grain size decreases toward the head of the estuary. The sediment falls into two populations, one from the main body of the estuary and the other from the tidal creeks. The main body population is nearly symmetrical to coarse skewed, moderately well to well sorted, and has graphic means between 1.25 and 2.90 phi. The tidal creek population is fine to very fine skewed, poorly sorted, and has graphic means ranging from 3.00 to 7.25 phi. (Knapp-USGS)
W71-00900

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

COMPARATIVE COST EVALUATION OF DESALTED WATER SUPPLY VERSUS ALTERNATIVE FRESHWATER SUPPLY FROM A CONVENTIONAL SOURCE,
Southwest Research Inst., Houston, Tex.
Donald E. Morris.
Water Resources Research, Vol 6, No 5, p 1487-1495, October 1970. 9 p, 5 tab, 5 ref, append.

Descriptors: *Desalination, *Water costs, *Cost-benefit analysis, *Saline water, *Water resources development, Water supply, Groundwater, Texas, Economics, Water wells, Aquifers, Water treatment, Water distribution (Applied), Water management (Applied).
Identifiers: Saline water resources.

A costing procedure was developed in Texas so that the cost of water produced by saline water conversion could be compared to the cost of an alternative freshwater supply from a conventional source. The cost of desalted water is generally higher than the cost of water from alternative sources. For desalting, the elements included in the costing procedure were: well fields for saline feedwater supply; intake system and pumping station; pipelines; pretreatment for saline water; the desalting plant; and brine disposal. For a conventional water supply system the elements of cost included were raw water cost; well field or intake system; pipeline and required pumping stations; and a conventional water treatment plant. The final economic justification of a desalination project may include such factors as chemical quality comparisons, secondary benefits, and project life comparison to future availability of alternative supply. The Texas Water Development Board considers that desalting is a very practical solution to the water supply problems that exist in many areas of the state. (Knapp-USGS)
W71-00569

NEED FOR SALINE GROUNDWATER DATA TO ADVANCE DESALTING TECHNOLOGY,
Office of Saline Water, Washington, D.C.
W. W. Rinne.
Water Resources Research, Vol 6, No 5, p 1482-1486, October 1970. 5 p, 2 tab, 6 ref.

Descriptors: *Water resources development, *Saline water, *Desalination, Groundwater, Aquifers, Systems analysis, Economics, Optimization, Injection wells, Waste water disposal, Brines, Brine disposal, Hydrogeology, Surveys, Reviews.
Identifiers: Saline water resources.

The use of desalting technology to supplement the water resources in semiarid areas of the United States indicates the need for more detailed information on the quantity and quality of saline groundwater supplies. The disposal of brine, a waste product of all desalting processes, poses a formidable problem at inland plant sites. Present work indicates that solar evaporation ponds and subsurface injection are the preferred methods of disposal. Injection, if employed, would require more data and information on the geologic and hydrologic features of subsurface formations. Systems studies relating the intake and brine disposal facilities with the desalting process are being conducted to achieve optimum system economics. (Knapp-USGS)
W71-00570

A REVIEW OF DESALINATION PROCESSES AND PRODUCT WATER COSTS,
Office of Saline Water, Washington, D.C.
W. F. Savage.
Water Resources Research, Vol 6, No 5, p 1449-1453, October 1970. 5 p, 4 fig.

Descriptors: *Desalination, *Water costs, *Desalination processes, *Reviews, *Surveys, Groundwater, Surface waters, Saline water systems, Desalination apparatus, Distillation, Reverse osmosis, Electrodialysis, Economics, Desalination plants.
Identifiers: Desalination costs.

The Office of Saline Water is conducting research and development in the basic desalination process areas of distillation, membrane, and crystallation. Processes in these areas include multistage flash distillation, vertical tube evaporation, vapor compression, reverse osmosis, electrodialysis, and vacuum freezing. Developmental plants have capacities up to approximately 2.5 million gallons per day. On the basis of test results, analytical studies, and supporting investigations, water costs have been reduced significantly over the past five years. Technological developments have resulted in a 25% reduction in water costs for distillation processes desalting seawater and a reduction by a factor of 3 for reverse osmosis processes desalting brackish water, considering a fixed plant size. Coupling of improved system technology with increasing plant size results in water costs that should be competitive with alternate means of supplying freshwater to major water consuming areas. (Knapp-USGS)
W71-00575

REORIENTATION OF OUR SALINE WATER RESOURCES THINKING,
Geological Survey, Washington, D.C.
F. A. Kohout.
Water Resources Research, Vol 6, No 5, p 1442-1448, October 1970. 7 p, 7 fig, 18 ref.

Descriptors: *Saline water, *Water resources development, *Desalination, Economics, Water costs, Groundwater, Saline water systems, Hydrogeology, Aquifers, Surveys, Reviews, Water storage, Injection wells, Water utilization, Water sources.
Identifiers: Saline water resources.

Desalination is currently one of the most important factors that conceptually change the direction of our investigation of the nations's water resources. Desalting costs have decreased from about $5 per 1000 gallons 10 years ago to about $1 per 1000 gallons for seawater distillation today. For membrane desalting of brackish groundwater, costs now range from 40 cents to $1 per 1000 gallons. Projected costs for desalting in the mid-1970's are in the range of from 25 to 50 cents per 1000 gallons at the plant, which is in the same range as consumer costs for delivered water in large cities in 1969. Thus, saline groundwater has developed considerable intrinsic worth. In addition, the pore space occupied by the saline water can be considered as a useful medium for storing natural gas, for artificial recharge, or for storing toxic industrial wastes. Great reliance must be placed on hydrologic prediction if haphazard interference of the various uses is to be avoided. Funding must be greatly expanded to provide necessary data on saline water systems. (Knapp-USGS)
W71-00576

HIGH-TEMPERATURE DESALINATION PLANTS FOR NUCLEAR-POWER STATIONS,
Baldwin-Lima-Hamilton Corp., Philadelphia, Pa.
R. A. Tidball, and J. G. Gaydos.
In: Nuclear Desalination - Proceedings of International Atomic Energy Agency Symposium, Madrid, Spain, November 18, 1968, p 495-506, Paper No SM-113/26, 1969. 12 p, 11 fig, 5 ref.

Descriptors: *Desalination plants, *Nuclear power plants, Facilities, Economics, Water costs, Distillation, Water quality, Sea water, Scaling.
Identifiers: Sea-water desalination.

The maximum temperature to which the brine can be heated in a MSF plant affects both the capital costs and energy costs charged to the product water. At the OSW East Coast Test Facility fresh sea water can be treated with sulphuric acid and heated in a 'once-through' plant to 300 deg F without scale formation in the condenser tubes. When this sea water is recirculated with or without concentration, scaling will occur at temperatures above 270 deg F. A combination of a 'once-through' high-temperature effect with either a single-effect multi-stage (SEMS) flash plant or a multi-effect multi-stage (MEMS) flash plant can be utilized to reduce both capital cost and energy charges. The purity of the product water from most MSF plants varies between 5 and 100 ppm TDS. Purer water can be made at an increase in capital cost. Make-up water for modern fossil-fuel boilers or for primary systems of nuclear reactors require water containing as little as 0.05 ppm. Generally, a small part of the product water of a desalination plant is passed through a demineralizer to obtain the desired purity for make-up. However, a method is available to produce a few percent of the total product as very high-purity water. This process is presented and included in the design of the proposed plants. The capital charges, energy charges and chemical charges are compared for 150-MGD plants using the SEMS, MEMS and the 'once-through' topping plant in combination with both. (Knapp-USGS)
W71-00614

DESALTING SALINE GROUNDWATER FOR IRRIGATION: A CASE STUDY, BUCKEYE, ARIZONA,
Bureau of Reclamation, Denver, Colo.; and Office of Saline Water, Washington, D.C.
Harold L. Parkinson, John T. Maletic, Joseph P. Wagner, and Milton S. Sachs.
Water Resources Research, Vol 6, No 5, p 1496-1500, October 1970. 5 p, 2 fig, 2 tab, 6 ref. Bureau of Reclamation and Office of Saline Water Research agreement 14-01-0001-1241.

Descriptors: *Irrigation water, *Desalination, *Cost-benefit analysis, *Arizona, Saline water systems, Groundwater, Water wells, Salinity, Saline water, Aquifers, Water yield, Water costs, Optimization, Model studies, Economics.
Identifiers: Saline water resources.

A study was made of a 1,376 acre irrigated area in Arizona to evaluate costs and benefits associated with desalting saline groundwater from seven wells as an improved water source for irrigation. Both multistage flash distillation (MSF) and electrodialysis (ED) processes were evaluated. Well water quality varied from 1580-4600 ppm; irrigation water qualities of 400, 900, and 1500 ppm are developed. Adaptable cropping patterns are selected for maximum returns. Direct, indirect, and public benefits for the projected year of 1990 are generated by shifts to higher value crops, intensive double cropping, increased crop yields, reduced water use, reduced fertilizer costs, reduced irrigation labor, and from increased flow of farm products. Costs are based on the desalting facilities, well water collection system, product storage reservoir, conveyance and distribution system, brine disposal system, blending facilities (MSF only), gypsum addition system (ED only), and water treatment facilities. Benefit-cost ratios increased with improved water quality. The most favorable benefit-cost ratio involved use of the ED process at a water quality level of 500 ppm. (Knapp-USGS)
W71-00837

SELECTIVE ELEMENT RECOVERY FROM OIL FIELD BRINES,
Kansas Univ., Lawrence.
Ernest E. Angino.
Water Resources Research, Vol 6, No 5, p 1501-1504, October 1970. 4 p, 4 fig, 1 tab, 9 ref.

Descriptors: *Oil fields, *Brines, *Byproducts, *Brine disposal, *Desalination, Water resources development, Oil industry, Injection wells, Costs, Water chemistry, Magnesium, Sulfur, Saline water.
Identifiers: Oil field brines, Saline water resources.

More than 325 billion gallons of oil field brines are brought to the surface yearly in the United States. In many instances the salts dissolved in oil field brines could be extracted profitably, if modern extraction techniques were used or refined. Simple extraction processes for soda ash, sodium carbonate, caustic soda, magnesium and calcium sulfate, trace elements and others are available. Magnesium can be precipitated in the hydroxide form and selected trace elements can be scavenged and concentrated by ferric iron precipitation. (Knapp-USGS)
W71-00841

ST. THOMAS 2.5 MGD COMBINED DESALINATION-POWER PLANT,
Baldwin-Lima-Hamilton Corp., Wrightsville Beach, N.C.
Robert A. Tidball.
Paper presented at PURAQUA, US Exhibition and International Conference on Water Purification

and Desalination, Rome, Italy, February 17-23, 1969. 5 p, 13 fig.

Descriptors: *Desalination plants, *Water costs, *Flash distillation, *Thermal powerplants, Virgin Islands, Economics, Desalination processes, Distillation, Steam turbines.
Identifiers: St. Thomas (V. I.).

The overall heat balance material balances, and economics for the combined power and desalination station at St. Thomas, Virgin Islands are summarized. The boiler is fired with 18,140 lbs. per hour of residual fuel oil. 233,093 lbs. per hr. of the 600 psig 825 deg F. steam is piped to the turbine generator set which produced 15,500 KW of saleable power. Bleed steam is removed at 26 psig and piped to the brine heater of the desalting plant, which produces 2,500,000 gpd of potable water. The water plant was designed to produce water containing less than 10 ppm total dissolved solids, using not more than 110,000 lbs./hr. of bleed steam from the turbine. Scaling of the heat transfer surfaces in the stage condensers and the brine heater was to be prevented by the use of sulfuric acid treatment to the make-up stream. The plant was designed for a 90% availability factor. The total cost is $641,000.00 per year. During the year, the plant could produce 825,000,000 gallons of water at a cost of 78 cents/thousand gallons. (Knapp-USGS)
W71-00890

OPERATING EXPERIENCES OF ONE MGD DESALINATION PLANT ON THE RED SEA,
Baldwin-Lima-Hamilton Corp., Philadelphia, Pa.
R. A. Tidball, J. G. Gaydos, and W. M. King.
Paper presented at Symposium on Western Water and Power, Los Angeles, Calif, April 8-9, 1968, p C43-C49, 1968. 7 p, 6 fig, 2 ref.

Descriptors: *Flash distillation, *Thermal power plants, *Water costs, Economics, Distillation, Corrosion, Desalination processes, Desalination plants.
Identifiers: Eilat (Israel).

A one MGD desalting plant was erected in conjunction with a 6700 kilowatt steam generating station in Eilat, Israel. The design, manufacture and construction of the plant are discussed. The operating history and performance of the first 2-1/2 year period are summarized. The effects of brine chemistry on corrosion, scaling and heat transfer are discussed with methods of selecting proper operating conditions. No calcium nor magnesium scale deposits have formed at any point in the system. The results of the corrosion tests, chemical analyses and visual inspection indicate that the plant should have an operating life in excess of thirty years. From December 21, 1965 to December 30, 1966 the plant produced 349 million gallons or 93% of the design capacity on a continuous basis. On a daily basis, the plant actually averaged 110% of design capacity. However, scheduled downtime for maintenance, along with periods when there was no demand for water, reduced the total annual production. From January 1, 1967 to the present, the plant has averaged about 105% of design. (Knapp-USGS)
W71-00896

SCALE CONTROL CUTS DESALTING COSTS...INCREASING PLANT OUTPUT BY 25 PERCENT,
Baldwin-Lima-Hamilton Corp., Wrightsville Beach, N.C. Industrial Equipment Div.
Robert A. Tidball.
Reprint from The American City, January 1967. 3 p, 3 fig, 2 photo.

Descriptors: *Desalination, *Pilot plants, *Sea water, Scaling, Flash distillation, Research and development.
Identifiers: *Scale control, *Thermal efficiency, Wrightsville Beach (NC).

A 25,000 gpd scale control, flash-distillation unit for desalting sea water was developed at Wrightsville Beach, N. C. The plant consists of two fabricated steel shells four feet in diameter and 35 feet long. Each contains two passes of four stages each for a total of 16 stages. With a 3 degree flashing range per stage, the plant can simulate any 16 consecutive stages operating over any 50 deg range between 100 and 400 deg F. The heat balance and operating flow of the pilot plant is illustrated. Results indicate that scale-free operation can be expected at 250 deg F in a recycle system with double strength sea water, and at 282 deg F with single strength sea water. In a once-through system, scale is not encountered below 300 deg F. (Woodard-USGS)
W71-00897

METHODS FOR SCALE CONTROL IN FLASH SYSTEMS,
Baldwin-Lima-Hamilton Corp., Wrightsville Beach, N.C. Seawater Research Lab.
R. A. Tidball, and R. E. Woodbury.
Paper presented at 1st International Symposium on Water Desalination, Wash, DC, October 1965. 7 p, 10 fig, 6 ref.

Descriptors: *Desalination, *Methodology, *Sea water, Scaling, Flash distillation, Research and development.
Identifiers: *Sea-water conversion, *Scale control, *Thermal efficiency.

Methods used to retard or prevent the formation of scale in sea-water evaporators described and evaluated. Pertinent diagrams included: (1) Thermal Diagram - Multi-Stage Recylce Flash Plant; (2) Solubility Curves of Scaling Compounds; (3) Scaling Conditions - pH Control; (4) Mechanism of Scale Formation in Submerged Tube Plants; (5) Mechanism of Scale Formation in Flash Plants; (6) Variation of Interfare Temperature with Mean Temperature Difference; (7) Variation of Interface Temperature with Brine Velocity; (8) Change in Heat Transfer with Time Seeding Techniques - Max. Brine Temp. 250 deg F; (9) Flow Sheet Showing Typical pH Scale Control System; and (10) Mems Plant Incorporating A 'Once Through' Effect and High Temperature Treatment of Make up Water. (Woodard-USGS)
W71-00899

3B. Water Yield Improvement

QUANTITATIVE MAPPING OF SALINITY, VOLUME, AND YIELD OF SALINE AQUIFERS USING BOREHOLE GEOPHYSICAL LOGS,
Geological Survey, St. Louis, Mo.; and Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 07C.
W71-00571

THEORETICAL ESTIMATES VERSUS FOREST WATER YIELD,
West Virginia Univ., Morgantown. Div. of Forestry.
R. Lee.
Water Resources Research, Vol 6, No 5, p 1327-1334, October 1970. 8 p, 3 tab, 27 ref.

Descriptors: *Rainfall-runoff relationships, *Water balance, *Water yield, *Mathematical models, Data collections, Streamflow, Percolation, Forests, Forest management, Safe yield, Surface drainage, Watershed management, Vegetation effects.
Identifiers: Forest hydrology.

Theoretical and empirical models used to estimate the long-term water balance of small catchments are inadequate as a check on the observed water balance. Under rigorous research conditions, the observational data are accurate to about 13-30% of yield, while the models are accurate only to about 10-60% of yield. Analysis of watershed data shows that the uncertainty in any comparison of theoretical and observed values usually is much greater than the difference between the values compared. In general, such comparisons are not helpful either in confirming or challenging the accuracy of water balance measurements, or in assessing the water-tightness of catchment areas. (Knapp-USGS)
W71-00587

RAINFALL ENHANCEMENT BY DYNAMIC CLOUD MODIFICATION,
Environmental Science Services Admin., Miami Univ., Coral Gables, Fla.; and Atlantic Oceanographic and Meteorological Lab.
William L. Woodley.
Science, Vol 170, No 3954, p 127-132, October 9, 1970. 6 p, 4 fig, 2 tab, 25 ref.

Descriptors: *Cloud seeding, *Artificial precipitation, *Silver iodide, Cloud physics, Weather modification, Florida, Convection, Environmental effects, Nucleation, Atmospheric physics.
Identifiers: *Dynamic cloud modification, Rainfall enhancment.

The relevance and reliability of seeding technology for practical uses are discussed and the results of a new experimental approach are given, in which massive silver iodide seeding caused rainfall increases from single clouds over southern Florida. In the Florida experiments, 19 clouds were used, 14 for seeding and 5 for control. Twenty 50-gram silver iodide pyrotechnics were dropped from aircraft into each cloud--10 on each of two mutually perpendicular passes near cloud top. The seeded clouds grew an average of 3,500 m more than the controls. Precipitation varied widely from cloud to cloud and from day to day, but seeded clouds rained twice as much as the unseeded clouds. Radar was the main tool for precipitation evaluation. In seeding for precipitation increases there are two approaches, static and dynamic, each involving different techniques and amounts of seeding material. Results depend on the initial conditions of the cloud-environment system. (Lang-USGS)
W71-00854

PRELIMINARY EVALUATION OF AVAILABILITY OF POTABLE WATER ON ELLIOTT KEY, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, Fla.
H. Klein.
Geological Survey Open-file Report 70010, 1970. 15 p, 1 fig, 2 tab, 4 ref.

Descriptors: *Water resources development, Water supply, *Fresh water, *Water resources, *Water management (Applied), *Florida, National parks, Rainfall, Groundwater, Shallow wells, Aquifers, Geology, Limestones, Salinity, Water storage, Water quality, Chlorides, Water analysis, Desalination.
Identifiers: Cisterns, Catchments.

The National Park Service is arranging for the purchase of Elliott Key and adjacent smaller keys in the upper Florida Keys, southeast of Miami, for the proposed Biscayne National Monument. Reviewed possibilities of potable water supplies that will be required in Elliott Key include shallow wells and water storage facilities during the rainy season; roof runoff into cisterns; paved catchments; blending water from different sources; and desalination of brackish water from the Floridan aquifer. Probably the most practical method is desalination. This is based on information on an artesian well drilled to 1,330 feet at the Pennekamp State Park in middle Key Largo and the reasonable cost of desalination by reverse osmosis. (Woodard-USGS)
W71-00881

ANNUAL REPORT OF PHREATOPHYTE ACTIVITIES - 1968,
Bureau of Reclamation, Denver, Colo. Office of Chief Engineer.
Philip M. Turner.

Bureau of Reclamation Report REC-OCE-70-27, July 1970. 21 p, 9 tab, 54 ref.

Descriptors: *Phreatophytes, Water resources, *Weed control, Ecology, *Water conservation, Evaporation, *Evapotranspiration, Vegetation, Water measurement, Forestry, Semiarid land, Lysimeters, *Herbicides, Prototype tests, Bibliographies, Consumptive use, Transpiration, Surfactants, Evaluation, *Tamarisk.

Bureau of Reclamation activities on phreatophyte research and control are described. Regional research contracts have been negotiated with universities in Arizona and Nevada. At Denver, Colo, saltcedar plants are greenhouse- and nursery-cultured and used as test specimens for foliar-applied herbicides. Herbicides are evaluated on saltcedar in plots along the Arkansas River near North Avondale, Colo. Helicopter herbicide spraying was performed on 920 acres (372 ha) of saltcedar at Rye Patch Reservoir by the Bureau and the Pershing County Water Conservation District. 14,000 acres (5,667 ha) of phreatophytes have been removed from the Colorado Indian Reservation near Parker, Ariz., since 1965. Phreatophytes have been controlled by tree crusher, root plow, cutter dozer, and spraying on 38,600 acres (15,645 ha) along the Pecos River in New Mexico.
W71-00911

CLOUD SEEDING, AREA OF EFFECT NUMERICAL MODEL,
Aerometric Research, Inc., Goleta, Calif.
For primary bibliographic entry see Field 02B.
W71-00912

SYNTHETIC HYDROPHOBIC SOILS FOR HARVESTING PRECIPITATION,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Dwayne H. Fink, and Lloyd E. Myers.
In: Symposium on Water-Repellent Soils, Proceedings, University of California, Riverside, May 6-10, 1968, Pub March 1969, p 221-240. 7 fig, 2 tab, 8 ref.

Descriptors: *Soil sealants, *Arid lands, *Precipitation (Atmospheric), *Runoff, *Water harvesting, Water conservation, Reservoirs, Soil physical properties, Soil texture, Porosity, Capillary action, Soil investigations, Soil structure, Soil water movement, Particle size, Soil surfaces, Repellents.
Identifiers: *Water-repellent soils, *Hydrophobic compounds, *Catchments, *Breakthrough pressure, Waterdrop contact angle, Effective soil pore radius, Silicones.

In areas of chronic water deficit improved runoff catchments coated with hydrophobic soils may be extremely useful. Of the many chemicals capable of creating water repellency in soils, sodium methylsilanolate (R-20) is the most promising and experiments were therefore undertaken to gauge its effectiveness. Soil breakthrough pressure (h) is directly proportional to the water drop contact angle and inversely proportional to the effective pore radius of the soil. Methods are described for measuring breakthrough pressure, contact angle, effective pore radius, soil particle size and soil surface areas in R-20 treated soils. Results showed that h increased directly with organic coverage and that sandy soils may be more effectively treated than finer textured soils because of their smaller surface area. All soils tested obtained an optimal monolayer coverage of 0.00003 grams R-20 per square meter of soil. At and beyond monolayer coverage the contact angle was relatively constant and about 150 degrees. Evaluation criteria and substances inducing soil repellency are discussed. (Casey-Arizona)
W71-00962

3C. Use of Water of Impaired Quality

SALINE GROUNDWATER RESOURCES OF THE CONTERMINOUS UNITED STATES,
Geological Survey, Menlo Park, Calif.
J. H. Feth.
Water Resources Research, Vol 6, No 5, p 1454-1457, October 1970. 4 p, 4 ref.

Descriptors: *Saline water, *Water resources development, *Reviews, Surveys, Saline water systems, Desalination, Desalination processes, Economics, Water costs, Groundwater basins, Surface waters, Groundwater, Hydrogeology.
Identifiers: Saline water resources.

Saline water is arbitrarily defined as water containing more than 1000 milligrams per liter of dissolved solids. Saline groundwater is known to underlie about two-thirds of the 48 states. Locally, aquifers yield saline groundwater in profuse quantities, some of which is used by industry, particularly for cooling. Generally, however, saline water has been considered a nuisance. In this report it is dealt with as a resource, especially for the future. Forty chemical types of mineralized groundwater were recognized, but sodium chloride dominates the occurrences and is almost the only type found where concentrations exceed about 20,000 mg/liter. The occurrence and hydrologic properties of saline water aquifers deserve much more study than they have had. (Knapp-USGS)
W71-00574

EFFECT OF VARIOUS SALINITY REGIMES ON GROWTH, LEAF EXPANSION AND TRANSPIRATION RATE OF BEAN PLANTS,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcano Institute of Agricultural Research; and Hebrew Univ. of Jerusalem (Israel).
A. Meiri, and Alexandra Poljakoff-Mayber.
Grant No. A10-SWC-7; FS-Is-179 from the U. S. Department of Agriculture. Soil Science, Vol 109, No 1, p 26-34, January 1970. 5 fig, 5 tab, 20 ref.

Descriptors: *Beans, *Salinity, *Plant growth, *Transpiration, *Leaves, Saline soils, Saline water, Salts, Salt tolerance, Semiarid lands, Sodium chloride, Irrigation water, Irrigation effects, Growth rates, Soil-water-plant relationships, Moisture content, Greenhouses.
Identifiers: *Leaf water content, *Irrigated agriculture, *Seedlings.

Bean seedlings in a greenhouse were subjected to various fluctuating salinity regimes in order to simulate field conditions occurring in areas with saline soils or saline water. Plant growth was retarded in all cases and transpiration was reduced by, and in proportion to, salinity. Leaf water content appeared to exert a strong influence on growth and transpiration. Growth retardation was found to be dependent on salinization rate, ultimate salinity level, and duration of seedling exposure to saline conditions. When plants were transferred from a saline to a non-saline medium, they demonstrated a transient burst of growth and an increase in transpiration rate. The seedlings, however, never reached the growth and transpiration levels of non-salinized control plants. The data indicate that under normal field conditions fluctuating salinity regimes will affect plant growth and transpiration less severely than, but similarly to, the constant salinity levels used in most experiments. (Carr-Arizona)
W71-00685

3D. Conservation in Domestic and Municipal Use

AREAWIDE WATER AND SEWER PLAN: COMPREHENSIVE PLANNING STUDY, CROSSETT, ARKANSAS.
Crossett Ashley County Joint Planning Commission, Ark.
For primary bibliographic entry see Field 05G.
W71-00788

SEWER AND WATER FACILITIES ANALYSIS.
Capital District Regional Planning Commission, Albany, N.Y.
For primary bibliographic entry see Field 05G.
W71-00790

REGIONAL WATER PLAN, PART I.
Heart of Texas Council of Governments, Waco.
For primary bibliographic entry see Field 06D.
W71-00794

RICHMOND REGIONAL WATER PLAN. AREA WIDE PLAN FOR LONG RANGE DEVELOPMENT.
Richmond Regional Planning District Commission, Va.
For primary bibliographic entry see Field 06D.
W71-00804

RICHMOND REGIONAL SEWERAGE PLAN. AREA WIDE PLAN FOR LONG RANGE DEVELOPMENT, TECHNICAL DATA.
Richmond Regional Planning District Commission, Va.
For primary bibliographic entry see Field 05G.
W71-00805

RECOMMENDED REGIONAL PLAN FOR SEWERAGE, WATER SUPPLY AND STORM DRAINAGE.
Valley Regional Planning Agency, Ansonia, Conn.
For primary bibliographic entry see Field 06B.
W71-00819

A MASTER WATER PLAN FOR UNION COUNTY, NEW JERSEY.
Union County Planning Board, N.J.

Available from NTIS as PB-192 856, $3.00 in paper copy, $0.95 in microfiche. April 1970, various pagings.
Identifiers: *Management planning, New Jersey, *New Jersey, *Water supplies, Analysis, Sources, Distribution, Statistical data, Feasibility studies, *Union County (New Jersey), Area planning and development, Water consumption.

The report presents A Master Water Plan for Union County, New Jersey. It includes the analysis of existing sources of supply and distribution system, as presented in the First Stage Report entitled 'Report Upon Water Supplies and Water Facilities in Union County' which has previously been submitted and approved. In this report, the adequacy of existing facilities is analyzed by comparing the safe yield of the existing sources of supply to the present and projected future water consumption. The ability of the existing distribution systems to meet the present and future demands has also been investigated. Recommendations for both short-term and long-range improvements are made. (See also W71-00826)
W71-00825

WATER SUPPLIES AND WATER FACILITIES IN UNION COUNTY.
Union County Planning Board, N.J.

Available from NTIS as PB-192 836, $3.00 in paper copy, $0.95 in microfiche. June 30, 1969, 39 p. Supplement, October 14, 1969, p 40-42.
Identifiers: *Management planning, New Jersey, *New Jersey, *Water supplies, Storage, Sources, Pipes, Chemicals, Water pollution, Storage tanks, Costs, Tables, Statistical data, Maps, *Union County (New Jersey), Area planning and development, *Water facilities.

The report is the first stage of a report dealing with utilities of Union County. The report includes: description of present water supply systems serving municipalities in Union County, including sources of supply, distribution systems and storage systems. The report is intended to describe the existing facilities. In addition the report contains basic data with regard to major pipelines, existing treatment facilities, location of storage tanks and other appurtenances which comprise the general inventory of the utilities. The report indicates the capacity and utilization of existing facilities as well as a determination of the existing facilities as well as a determination of the existing facilities capable to serve present requirements. (See also W71-00827)
W71-00826

STORM DRAINAGE FACILITIES, UNION COUNTY, NEW JERSEY.
Union County Planning Board, N.J.

Available from NTIS as PB-192 822, $3.00 in paper copy, $0.95 in microfiche. May 1970, various pagings.
Identifiers: *Management planning, New Jersey, *Floods, Drainage, Storms, Structures, Rainfall, Storage, Fluid flow, Rivers, Design, Tides, Pipes, Inland waterways, Roads, Maps, *Union County (New Jersey), Area planning and development, *Storm sewers.

The report presents an inventory and analysis of the storm drainage facilities of Union County, New Jersey. Points of analysis were generally selected where streams cross major County thoroughfares. The tributary area to each of these points were determined. Estimates of minimum design flows were prepared. These suggest minimum design flows were then used to determine the adequacy of the existing drainage facility at the point of analysis. The second stage of this report will analyze tidal influence upon storm drainage facilities and present a recommended plan of improvements. (See also W71-00825)
W71-00827

WATER SUPPLY AND SEWAGE DISPOSAL.
Rensselaer County Dept. of Planning and Promotion, Troy, N.Y.

Available from NTIS as PB-192 431, $3.00 in paper copy, $0.95 in microfiche. 1968, 110 p. HUD Project N.Y. P-168.
Identifiers: *Management planning, New York, *Water supplies, Statistical analysis, *Sewage, Disposal, Population, Volume, Costs, Analysis, Statistical data, Urban areas, Rural areas, Storms, Drainage, Maps, *Rensselaer County (New York), *Area planning and development, *Cost analysis.

These facilities have been separately examined but are included in a single report. The section of water supply consists of a basic inventory of the existing water systems, their capacity, the number of people served, and the per capita consumption. Also presented is a cost analysis for each community serviced. The section on sewers includes an inventory of the existing sewers and storm water facilities and explanations of the districts proposed by the County, one of the towns, and by three of the villages. Appropriate maps and cost estimates for the new districts are also included.
W71-00828

3E. Conservation in Industry

AREAWIDE WATER AND SEWER PLAN: COMPREHENSIVE PLANNING STUDY, CROSSETT, ARKANSAS.
Crossett Ashley County Joint Planning Commission, Ark.
For primary bibliographic entry see Field 05G.
W71-00788

MANAGING THE NATURAL ENVIRONMENT: A REGIONAL PLAN FOR WATER, SEWAGE, AIR AND REFUSE,
Tri-State Transportation Commission, New York.
For primary bibliographic entry see Field 05G.
W71-00829

SELECTIVE ELEMENT RECOVERY FROM OIL FIELD BRINES,
Kansas Univ., Lawrence.
For primary bibliographic entry see Field 03A.
W71-00841

WATER POLLUTION CONTROL CREATES DEMAND FOR GROUNDWATER HYDROLOGISTS,
Geological Survey, Denver, Colo. Water Resources Div.
For primary bibliographic entry see Field 05G.
W71-00848

QUANTITATIVE ANALYSIS OF INDUSTRIAL WATER-USE PATTERNS IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Water Resources Research Inst.
For primary bibliographic entry see Field 06D.
W71-00902

3F. Conservation in Agriculture

STEADY INFILTRATION FROM LINE SOURCES AND FURROWS,
Agricultural Research Service, Madison, Wis., and Wisconsin Univ., Madison. Coll. of Agriculture.
For primary bibliographic entry see Field 02G.
W71-00558

LEACHING OF CROP RESIDUES AS A SOURCE OF NUTRIENTS IN SURFACE RUNOFF WATER,
Agricultural Research Service, Morris, Minn.; and Minnesota Univ., Morris.
For primary bibliographic entry see Field 05B.
W71-00584

FERTILIZER USE AND WATER QUALITY,
Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 05A.
W71-00639

RISING WATER VALUES THAT RESULT FROM INCREASED MOBILITY,
Utah State Univ., Logan. Dept. of Agricultural Economics.
B. Delworth Gardner, and Herbert H. Fullerton.
Available from NTIS as PB-195 311, $3.00 in paper copy, $0.95 in microfiche. Bulletin, 476, October, 1968. 27 p, 6 tab, 3 fig. OWRR Project B-009-UTAH (9).

Descriptors: *Water transfer, Water rights, Utah, *Irrigation, Institutions, *Costs, *Rent, Evaluation.

This bulletin indicates the gains in the value of water that occurred in one irrigation district in Utah when transfers were permitted between irrigation companies after many years of the typical practice of restricting transfers to those within a given company. The exposition presents a description of the institutional setting before and after the transfer impediment was relaxed; a discussion of the development of the rental market; appraisal of the relation between transfer flexibility and economic efficiency; reporting of rental values and an identification of the variables influencing rental values; and presentation of the statistical results.
W71-00684

EFFECT OF VARIOUS SALINITY REGIMES ON GROWTH, LEAF EXPANSION AND TRANSPIRATION RATE OF BEAN PLANTS,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcano Institute of Agricultural Research; and Hebrew Univ. of Jerusalem (Israel).
For primary bibliographic entry see Field 03C.
W71-00685

THE GOLODNAYA STEPPE: A RUSSIAN IRRIGATION VENTURE IN CENTRAL ASIA,
Michigan State Univ., East Lansing. Dept. of Geography.
Ian M. Matley.
Geographical Review, Vol 60, No 3, p 328-346, July 1970. 3 fig, 28 ref.

Descriptors: *Water utilization, *Arid lands, *Irrigation canals, *Cotton, *Economic feasibility, Government finance, Diseconomies of scale, Depreciation, Economic efficiency, Project planning, History, Economic justification, Financial feasibility, Project feasibility, Concrete-lined canals, Irrigation canals, Canal construction, Salinity, Irrigation systems, Feasibility studies, Crop production.
Identifiers: *Soviet Union, *Turkmenian Desert, *Golodnaya Steppe.

The Golodnaya Steppe in Turkestan is an arid, fertile rolling plain of about 700-800 feet elevation bordering a long river, the Syr Darya. In 1870 the Czarist authorities began long range feasibility studies on extensive irrigation projects in the area in order to eliminate national dependence on imported cotton. The construction and improvements of various canal systems over the next 45 years are described. By 1916, 35,000 hectares were under irrigation, but problems of salinity, waterlogging and malaria had developed and the economics of the scheme were in doubt. Although the irrigated land fell into disuse during the revolution, the Soviet government continued the project with an eventual goal of 500,000 hectares. By 1940, 138,000 hectares were under irrigation, of which 63,000 hectares were in cotton with an average yield of 1770 kilograms per hectare. In 1967, 300,000 hectares were irrigated, but the old problems of salinity were worsening and yield per acre had declined considerably. Despite the enormous investment in the project by the Soviets, increases over achievements of the Czarist government were relatively small in comparison to cost and the goal of independent cotton production may be economically unrealistic. (Casey-Arizona)
W71-00692

METHOD FOR DISCHARGE MEASUREMENTS IN IRRIGATION OUTLETS,
Technion - Israel Inst. of Tech., Haifa. Dept. of Civil Engineering.
M. H. Diskin.
Journal of Agricultural Engineering Research, Vol 13, No 4, p 350-357, December 1968.

Descriptors: *Discharge measurements, *Discharge (Water), *Outlets, *Pipe flow, *Irrigation engineering, Flow measurement, Pipes, Flowmeters, Equations, Hydraulics, Irrigation, Irrigation water.
Identifiers: *Critical depth, *Depth of flow, *End depth, *Irrigation outlets.

Discharge from irrigation outlet pipes (horizontal circular channels) was calculated by measuring the depth of flow at a station located 5.2 D from the end of the outlet. In experiments on 6, 8, 10, and 16 in. pipes, discharge was found to be functionally related to depth at the measuring station. The equation expressing this relationship is Q/ (g D super 5) super 1/2 equals 0.884 (h sub s/D) super 2.23, where Q is channel discharge, g is acceleration due to gravity, D is diameter of the circular channel, and h sub s is depth of flow at the measuring station. Small flow disturbances at the end of the outlet do not affect the relationship. This new method of calculating discharge from irrigation outlets appears to overcome some of the difficulties of two presently used methods, since it does not require any attachments to the end of the pipe and the measuring station is located upstream of the end section. (Carr-Arizona)
W71-00694

NITROGEN AND PHOSPHORUS FERTILIZATION FOR PRODUCTION OF CRESTED WHEATGRASS AND NATIVE GRASS IN NORTHEASTERN MONTANA,
Agricultural Research Service, Bozeman, Mont. Northern Plains Branch; and Montana Agricultural Experiment Station, Bozeman.
For primary bibliographic entry see Field 02I.
W71-00695

AMITROLE RESIDUES AND RATE OF DISSIPATION IN IRRIGATION WATER,
Agricultural Research Service, Denver, Colo. Crops Research Div.; and Agricultural Research Service, Prosser, Wash. Crops Research Div.
Robert J. Demint, Peter A. Frank, and Richard D. Comes.
Weed Science, Vol 18, No 4, p 439-442, July 1970. 3 fig, 4 tab, 5 ref.

Descriptors: *Aminotriazole, *Irrigation water, *Irrigation canals, *Laterals, *Aquatic weed control, Herbicides, Weed control, Irrigation, Irrigation ditches, Washington, Colorado, Sampling.
Identifiers: *Herbicide residues, *Rate of dissipation.

A single ditchbank on two different canals were treated with 4.5 and 3.4 kg/ha of amitrole-T (amitrole-ammonium thiocyanate). Subsequent maximum concentrations of amitrole (3-amino-striazole) in the flowing water (1.13 and 0.65 cu m/sec) were 31 and 43 ppb, respectively. Both banks of another canal were treated before the turning of 1.42 cu m/sec of water into the canal, resulting in a maximum reading of 98 ppb of amitrole. Two hours after the main body of amitrole-bearing water had past the last sampling station, amitrole levels in each canal were down to 1 ppb or less. For distances up to about 14.5 km, amitrole dissipation in canals was a linear function of the herbicide concentration and the downstream flow. The dissipation rate was slowest when opposite canal banks were treated, medium when single banks were treated, and fastest when the herbicide was added directly to the water. Since amitrole is used to treat the banks of irrigation canals, this information should be useful when irrigation water is applied to crops which are intolerant of high herbicide levels. (Carr-Arizona)
W71-00698

IRRIGATION STUDIES ON COTTON: II. BOLL WEIGHT AND FIBRE PROPERTIES,
Central Arid Zone Research Inst., Jodhpur (India).
Kumar Vijay, and P. C. Raheja.
Annals of Arid Zone, Vol 8, No 1, p 105-108, 1970. 2 tab, 12 ref.

Descriptors: *Cotton, *Fibers (Plant), *Irrigation effects, *Soil moisture, *Arid lands, Crop production, Irrigation, Furrow irrigation, Sprinkler irrigation, Flood irrigation, Irrigation systems, Soil-water-plant relationships, Moisture availability.
Identifiers: *Irrigated agriculture, *Boll weight, Rajasthan (India).

Three varieties of long staple cotton, 216 F, H sub 14, and Andrews, were studied in western Rajasthan (India) in order to determine the effect of irrigation on boll weight and cotton fiber properties. Three soil moisture levels (0.3 atm, 0.6 atm, and 0.85 atm) and three irrigation methods (flat, furrow, and sprinkler) were tested in all possible combinations with the cotton varieties. The various boll and fiber characteristics of 216F and H sub 14 were quite similar. Both of the varieties yielded significantly higher boll numbers, dry weight of bolls per plant, ginning out turn, and strength of fiber than Andrews. However, Andrews showed higher 500-seed weight and mean fiber length than the other two varieties. Most fiber properties were not affected by the various irrigation methods, but fiber strength was significantly increased by flat irrigation over furrow irrigation in the first year. Soil moisture levels at 0.3 atm were superior to 0.85 atm for mean fiber length, but in 1963 the reverse was true for fiber strength. (Carr-Arizona)
W71-00703

IRRIGATION STUDIES ON COTTON IN ARID ZONE: I. EFFECT OF VARIOUS METHODS OF IRRIGATION AND LEVELS OF SOIL MOISTURE ON GROWTH AND YIELD OF THREE VARIETIES OF COTTON,
Central Arid Zone Research Inst., Jodhpur (India).
Kumar Vijay, and P. C. Raheja.
Annals of Arid Zone, Vol 8, No 1, p 98-104, 1970. 5 tab, 23 ref.

Descriptors: *Cotton, *Irrigation effects, *Soil moisture, *Plant growth, *Arid lands, Crop production, Irrigation, Furrow irrigation, Sprinkler irrigation, Flood irrigation, Irrigation systems, Moisture availability, Soil-water-plant relationships, Seeds.
Identifiers: *Irrigated agriculture, *Rajasthan (India).

Three varieties of long staple cotton, 216F, H sub 14, and Andrews, were studied in western Rajasthan (India) in order to determine the effect of irrigation on growth, yield, and quality of cotton. Three soil moisture levels (0.3 atm, 0.6 atm, and 0.85 atm) and three irrigation methods (flat, furrow, and sprinkler) were tested. Cotton variety Andrews appeared totally unsuited to arid climates. Varieties 216F and H sub 14 grew well and showed little difference in growth and yield characteristics. There was no marked difference in results between furrow and sprinkler irrigation. Both systems were consistantly superior to the flat method. Water availability to plants decreased progressively from 0.3 to 0.85 atm tension, significantly reducing plant growth and seed yield. It appears that irrigation between 0.3 and 0.6 atm is best. (Carr-Arizona)
W71-00704

ENGINEERING COST ANALYSIS FOR BEAVER IRRIGATION PROJECT.
Ozarks Regional Commission.

Available from NTIS as PB-191 695, $3.00 in paper copy, $0.95 in microfiche. 1970. 10 p, maps.
Identifiers: *Agriculture, *Aarkansas, *Irrigation systems, Costs, Water supplies, Natural resources, Dams, Feasibility studies, Statistical data, Systems engineering. Benton County (Arkansas), Washington County (Arkansas), Agricultural engineering.

The document contains an engineering analysis and report on development of a proposed water distribution system for irrigation in parts of Benton and Washington Counties, Arkansas. The report involves application of engineering techniques to investigate the cost to supply irrigation water to the project area with subsequent costs to distribute this water on-farm.
W71-00812

CONSUMPTIVE USE OF IRRIGATION WATER IN WYOMING,
Wyoming Univ., Laramie. Water Resources Research Inst.
Frank J. Trelease, Paul A. Rechard, Theodore J. Swartz, and Robert D. Burman.
Available from NTIS as PB-195 624, $3.00 in paper copy, $0.95 in microfiche. Wyoming Water Resources Research Institute, Water Resources Series No 19/Wyoming Water Planning Report No 5. July, 1970. 103 p, 4 tab, 7 fig, 2 maps, 10 ref, append. OWRR Project B-003-WYO (1).

Descriptors: *Consumptive use, *Irrigation practices, *Water use, *Planning, Effective precipitation, Climatic data, Evapotranspiration, Computer programs, Wyoming, Water resources development.

It is essential that irrigation water requirements and consumptive uses of water be known, when planning for water resource development at any level of government. The Blaney-Criddle Method of estimating consumptive use was chosen to provide guidelines of water use throughout Wyoming because it is widely accepted, is easy to use, and utilizes readily available climatic data. A digital computer program for solution of the method was prepared and data for fifty-six climatological stations in Wyoming are presented. (Rechard-Wyoming)
W71-00901

CATTLE FEEDERS AVOID POLLUTION BY USING WASTES IN IRRIGATION.
Soil Conservation Service, Washington, D.C.
For primary bibliographic entry see Field 05G.
W71-00939

IRRIGATING WITH ANIMAL WASTE,
Soil Conservation Service, Hermiston, Oreg.
For primary bibliographic entry see Field 05G.
W71-00941

A RATIONAL APPROACH TO THE DESIGN OF CHECK SYSTEMS OF IRRIGATION,
Punjab Agricultural Univ., Hissar (India). Dept. of Agricultural Engineering.
V. V. N. Murty, and M. C. Agarwal.
Journal of Agricultural Engineering Research, Vol 15, No 2, p 163-170, June 1970. 3 fig, 2 tab, 4 ref.

Descriptors: *Irrigation design, *Percolation, *Soil moisture, *Soil physical properties, *Streamflow, Irrigation, Irrigation water, Surface irrigation, Hydraulics, Field capacity, Bulk density, Soil density, Infiltration, Wilting point, Equations, Mathematical models.
Identifiers: *Check irrigation, *Percolation losses.

A seven-step method is presented by which the size of check can be determined from known stream size and soil characteristics. The technique is supposed to overcome the inadequacies of the presently used Israelsen formula, especially in the area of percolation losses. Irrigation studies have shown that some percolation loss inevitably results when completely irrigating a plot, but this loss can be reduced by utilizing larger stream size. In this way percolation losses are lowered by reducing the time of initial water spread. A mathematical expression is derived for determining percolation losses under a given set of conditions. The article includes a nomograph for use in such a determination. (Carr-Arizona)
W71-00951

RECLAMATION OF A SALINE-ALKALI SOIL IN THE UPPER INDUS BASIN,
H. S. Zaidi, M. A. Nur-ud-din, K. D. Qayyum, and K. D. Gowans.
Pakistan Journal of Science, Vol 20, No 4, p 170-177, July 1968. 2 fig, 2 tab, 3 ref.

Descriptors: *Reclamation, *Saline soils, *Alkaline soils, *Leaching, *Soil amendments, Soil profiles, Soil chemical properties, Soil conservation, Gypsum, Rice, Calcium, Carbonates, Sodium, Solubility, Solutes, Organic matter, Ion exchange,

Sampling, Salts, Soil analysis, Hydrogen ion conentration, Crop production, Wheat.
Identifiers: *West Pakistan, *Upper Indus Basin.

Soil profile analyses in the Upper Indus Basin of West Pakistan indicate that about 85% of the salt-affected soils are either saline-alkali or alkali. Reclamation by simple leaching is not feasible because of slowly soluble Ca carbonate which replaces exchangeable Na. Therefore, experiments were begun using amendments – gypsum, S and organic matter-which increase Ca carbonate solubility. Plots on barren, salt-affected land were treated with either 2 or 5 tons gypsum/acre, 20 tons of barnyard manure/acre or 5 tons gypsum and 20 tons barnyard manure/acre. Some were left untreated. Subsequently, the plots were leached and planted to rice crops. Yields in terms of gross income minus amendments, were compared. They were significantly higher than those of untreated plots and the results indicated best success with the combination of 2 tons gypsum and 20 tons barnyard manure/acre. (Casey-Arizona)
W71-00952

IRRIGATED CASTORBEAN, SOYBEAN, AND SAFFLOWER TRIALS AT THE NORTHEASTERN BRANCH STATION,
New Mexico Agricultural Experiment Station, University Park.
For primary bibliographic entry see Field 02I.
W71-00964

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

EQUATIONS FOR APPROXIMATING VERTICAL NONSTEADY-STATE DRAINAGE OF SOIL COLUMNS,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02G.
W71-00552

RIVER FLOW FORECASTING THROUGH CONCEPTUAL MODELS, PART III – THE RAY CATCHMENT AT GRENDON UNDERWOOD,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 02E.
W71-00591

FEASIBILITY OF A PERIODIC FLUSHING SYSTEM FOR COMBINED SEWER CLEANSING.
FMC Corp., Santa Clara, Calif. Central Engineering Labs.
For primary bibliographic entry see Field 05G.
W71-00623

THE GOLODNAYA STEPPE: A RUSSIAN IRRIGATION VENTURE IN CENTRAL ASIA,
Michigan State Univ., East Lansing. Dept. of Geography.
For primary bibliographic entry see Field 03F.
W71-00692

METHOD FOR DETERMINATION OF SAFE YIELD AND COMPENSATION WATER FROM STORAGE RESERVOIRS,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Leo R. Bearch.
Tech Paper No 3, The Hydrologic Engineering Center, Corps of Engineers, US Army, Aug 1965. 15 p, 17 ref.

Descriptors: *Simulation analysis, *Reservoirs, *Reservoir operation, Optimization, Streamflow.

The trend toward multiple use of reservoir space and the consideration of prior rights and legal restrictions dictate that a detailed sequential analysis of inflows, outflows and operation factors be made. These principles are used in the determination of reservoir yield, regardless of the nature or type of water supply reservoir. Three types of reservoirs considered were designed for this report: (a) impounding reservoirs from which water supply is piped direct to destination, (b) regulating reservoirs from which water is released to the river for downstream use, and (c) pump storage reservoirs into which water is diverted or pumped from the river for future use. The basic procedure used throughout the United States consists of performing a reservoir routing or reservoir simulation study which require considerable time and effort. The general procedure for performance of a detailed project routing study was described. The steps included: (a) determination of non-project streamflow at each reservoir site and at downstream points of diversion, (b) determination of monthly firm supply, (c) determination of monthly reservoir stage limitations, (d) determination of expected average monthly evaporation and seepage loss, (e) development of the relation of river percolation losses to rate of flow, (f) development of the multi-reservoir operation criteria, (g) establishment of criteria for allowable shortages, (h) establishment of initial reservoir stage, and (i) performance of routing operation. Mentioned was the fact that considerable effort is being currently devoted to obtaining more dependable measures of potential streamflow by use of streamflow simulation procedures. Has 17 references. (Kriss-Cornell)
W71-00711

A HYDROLOGIC WATER RESOURCE SYSTEM MODELING TECHNIQUE,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
L. G. Hulman, and D. K. Erickson.
Tech Paper No 16, The Hydrologic Engineering Center, Corps of Engineers, US Army. 31 p, 6 fig, 6 tab.

Descriptors: *Mathematical models, *Simulation analysis, *Hydrologic properties, *Delaware River, *Streamflow, *Reservoirs, Droughts, Computer programs, Gaging stations, Design.

The record Northeastern United States drought of the 1960's necessitated a detailed reappraisal of water resource systems previously proposed in the affected areas. To facilitate analysis of the effects of the drought, a mathematical modeling technique was developed to allow simulation of the hydrologic properties of the lower Delaware River basin and included eight water resources projects. Modeling requirements considered were: flow records, flow requirements, reservoir operation, and routing requirements. The reservoir system, the general method of analysis and its internal and external constraints were discussed. The final requirements for the model were the determination of the locations of streamflow simulation in the model the 'design' features to be studied, and the statement of the logical methodology required for conversion to instructions necessary for computer processing. Fifteen gaging stations were used as key flow points in the model. Inflows into the reservoirs were computed either by simple drainage area ratios when records were available or by correlation relationships with streamflow data elsewhere in the area where records were not available. (Kriss-Cornell)
W71-00712

WORTH OF STREAMFLOW DATA FOR PROJECT DESIGN - A PILOT STUDY,
Geological Survey, Sacramento, Calif. Hydrologic Systems Lab.; and Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
D. R. Dawdy, H. E. Kubick, L. H. Beard, and E. R. Close.
Tech Paper No 8, The Hydrologic Engineering Center, US Army Corps of Engineers, April, 1968. 9 p, 2 fig, 2 tab, 1 append, 5 ref.

Descriptors: Optimization, *Simulation analysis, *Optimum development plans, *Streamflow, *Design data, *Reservoir design, Multiple-purpose reservoirs, Statistical methods, California.
Identifiers: Historical record.

A procedure for evaluating the worth of streamflow data for project design was described and a simplified example was shown. The present study assessed the effect of sampling error on the worth of data used for ultimate reservoir design. The contemplated methodology as applied in a limited manner to one location for design of a multipurpose reservoir for water supply and low flow regulations, with flood control and minimum pool fixed, was examined. In order to assess the effect of sampling errors in streamflow data on reservoir design, several factors were considered. First, a 'true'optimum design must be known, so that departures from the true design could be measured. Second, the variability of the departures from the true design should depend upon the length of record used for design purposes and statistical properties of the streamflow for the basin to which the design is applied. The Streamflow record for Arroyo Seco near Soledad, California was used. The measured record of flow was used to establish statistics describing the historical record. A 500-year base 'record' was simulated with statistical properties similar to the measured record and was used to determine an optimum design for a simplified multipurpose reservoir for both a 'high' and a 'low' yield at the site. (Kriss-Cornell)
W71-00714

COMMUNITY GOALS-MANAGEMENT OPPORTUNITIES: AN APPROACH TO FLOOD PLAIN MANAGEMENT
Chicago Univ., Ill. Center for Urban Studies.
For primary bibliographic entry see Field 06B.
W71-00736

JOHNSON V DRAKE (LIABILITY FOR FLOOD DAMAGE CAUSED BY BACKWATER).
For primary bibliographic entry see Field 06E.
W71-00756

SOUTHERN RY V NEAL (RAILROAD'S LIABILITY FOR FLOODING CAUSED BY INADEQUATE CULVERT).
For primary bibliographic entry see Field 06E.
W71-00760

PURSEL V POLSTER (LOWER RIPARIAN OWNER IS ESTOPPED FROM DENYING THE RIGHT TO DRAW WATER TO SUPPER RIPARIAN OWNER WHO HAD OBTAINED PREVIOUS PERMISSION FROM LOWER OWNER).
For primary bibliographic entry see Field 06E.
W71-00792

NAPORRA V WECKWERTH (ACQUSITION OF PRESCRIPTIVE RIGHT TO DRAIN SURFACE WATER).

226 NW 569-572 (Minn 1929).

Descriptors: *Minnesota, *Prescriptive rights, *Easements, *Surface drainage, Surface runoff, Drainage, Drainage water, Surface waters, Watercourses (Legal), Natural flow, Land tenure, Ditches, Tile drains, Judicial decisions, Legal aspects, Damages.

Plaintiff sought damages for and relief from defendant's obstruction of the flow of surface water from plaintiff's land through a ditch located on defendant's land. The evidence showed that plaintiff's grantor had constructed the ditch on defendant's

grant's land, that plaintiff had on occasion cleaned such ditch, that defendant had seven years earlier put tile in the ditch and that defendant had filled in a hole on his land so that the ditch could not function. The jury found plaintiff had not been damaged, but that he had acquired a prescriptive right to drain water from his land through the ditch. The Supreme Court of Minnesota affirmed. The court stated that the character of the usage of an easement which will ripen into a legal right by prescription is the same as is required to gain title to land by adverse possession. Defendant had contended that his grantor had only given permission to use the ditch for drainage. However, the court held that the evidence was such as to warrant an inference that plaintiff's grantor had entered adversely to defendant's grantor and that defendant's grantor had merely acquiesced in the construction of a drainage ditch through his land. (Duss-Florida)
W71-00808

WATER RELATED LAND USE IN THE WEBER RIVER DRAINAGE AREA,
Utah Water Research Lab., Logan.
Frank W. Haws.
Available from NTIS as PB-191 586, $3.00 in paper copy, $0.95 in microfiche. February 1970. tables, maps. PRWG 40-4.
Identifiers: *Water supplies, *Utah, *Hydrology, Management planning, *Rivers, Drainage, Rural areas, Water supplies, Agriculture, Irrigation systems, Statistical data, Urban areas, Classification, Mountains, Photogrammetry, Lakes, Industries, Plants (Botany), Evaporation, Tables, Maps, Weber River, *Land use, *Regional planning and development.

The Utah Department of Natural Resources, Division of Water Resources (formerly the Utah Water and Power Board) has been charged by the State Legislature with the responsibility of developing a state water plan which would coordinate and give direction to the activities of all state and federal agencies concerned with Utah's water resources. One of the first steps to accomplish this purpose was to divide the state into 10 natural drainage basins and then proceed to inventory and analyze the water resources within each basin. One of the major items to consider in such a study is the amount of water depleted from the basin through the processes of evaporation and transpiration.
W71-00815

STORM DRAINAGE: INVENTORY AND ANALYSIS OF MAJOR EXISTING AND PLANNED FACILITIES. VOLUME V: STORM DRAINAGE.
Valley Regional Planning Agency, Ansonia, Conn.
For primary bibliographic entry see Field 06B.
W71-00820

CHANNEL IMPROVEMENT, FIRE ISLAND INLET, NEW YORK. HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W71-00822

STORM DRAINAGE FACILITIES, UNION COUNTY, NEW JERSEY.
Union County Planning Board, N.J.
For primary bibliographic entry see Field 03D.
W71-00827

BEACH PROFILE AS AFFECTED BY VERTICAL WALLS,
California Univ., Berkeley. Hydraulic Engineering Lab.
For primary bibliographic entry see Field 02J.
W71-00833

FLOOD PLAIN INFORMATION, GASTONIA, NORTH CAROLINA.
Corps of Engineers, Charleston, S.C.

Corps of Engineers Flood Plain Report, September 1970. 80 p, 30 fig, 32 plate, 17 tab.

Descriptors: *Floods, *Flood damage, *North Carolina, Flood plains, Regional flood, Flood forecasting, Flood control, Streamflow, Flow measurement, Bridges, Historic flood.
Identifiers: *Flood records, Standard project flood, Intermediate regional flood.

Flooding along Crowders, Blackwood, Long, Catawba, Duhart and Avon Creeks in the vicinity of Gastonia, North Carolina is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections, and text material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. (Woodard-USGS)
W71-00846

FLOOD PLAIN INFORMATION, LITTLE, BOLIN, BOOKER AND MORGAN CREEKS, CHAPEL HILL, NORTH CAROLINA.
Corps of Engineers, Wilmington, N.C.

Corps of Engineers Flood Plain Report, May 1970. 52 p, 11 fig, 28 plate, 18 tab.

Descriptors: *Floods, *Flood damage, *North Carolina, Flood plains, Regional flood, Flood forecasting, Flood control, Historic flood.
Identifiers: *Flood records, *Chapel Hill area (N.C.), Standard project flood, Intermediate regional flood.

Flooding along Morgan, Little, Bolin, and Booker Creeks in the vicinity of Chapel Hill, North Carolina is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections, and text material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. (Woodard-USGS)
W71-00847

SUSQUEHANNA RIVER BASIN STUDY--A PREVIEW.
Susquehanna River Basin Study Coordinating Committee, Baltimore, Md.

Corps of Engineers, Baltimore District Report, June 1970. 25 p, 21 photo, 6 maps.

Descriptors: *River basin development, *Water resources development, *Land development, Flood control, Planning, Water pollution control, Reclamation, Water quality, Water supply, Reservoirs, Recreation, Abatement, Cost analysis, New York, Pennsylvania, Maryland.
Identifiers: *Susquehanna River basin (NY, Penn, and Md), Streambank stabilization.

This brochure is a brief summary of the Susquehanna River Basin Study made by various Federal and State agencies under the broad guidance of the Study's Coordinating Committee. In response to requests from basin residents, the United States Senate, by a resolution of its Committee on Public Works in 1961, requested that a comprehensive plan be prepared 'for the development of the water and related land resources of the Susquehanna River basin in the States of New York, Pennsylvania, and Maryland.' The study was to be carried out 'in the combined interest of flood control, navigation, water supply, recreation, pollution abatement, and other beneficial water uses.' The House of Representatives, by a similar resolution of its Committee on Public Works, joined with the Senate in its request. The main report will be presented by the Coordinating Committee to the Water Resources Council which will vorward it to the President and the Congress. (Woodard-USGS)
W71-00852

AN UNCONVENTIONAL APPROACH TO FLOOD FREQUENCY ANALYSIS,
Technion - Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 02A.
W71-00861

CHURCHILL V HARRIS (RIGHT TO ENTER LAND TO EXERCISE WATER RIGHTS).
For primary bibliographic entry see Field 06E.
W71-00871

ROTARY VIBRATORY FINE SCREENING OF COMBINED SEWER OVERFLOWS,
Cornell, Howland, Hayes and Merryfield, Corvallis, Oreg.
For primary bibliographic entry see Field 05G.
W71-00872

THURSTON V CARTER (BREACH OF CONTRACT TO KEEP TITLE DITCH OPEN).
For primary bibliographic entry see Field 06E.
W71-00873

CHELTENHAM AND ABINGTON SEWERAGE CO V PUBLIC SERVICE COMM'N (DEDICATION OF SEWERAGE SYSTEM).
For primary bibliographic entry see Field 06E.
W71-00874

WEISBERGER V MAURER (DISCHARGE OF SURFACE WATER ONTO ADJOINING LAND).
For primary bibliographic entry see Field 06E.
W71-00875

SEWER MONITORING AND REMOTE CONTROL-DETROIT.
Detroit Metro Water Services, Mich.
For primary bibliographic entry see Field 05G.
W71-00876

FAIRLAWN MANOR HOMES CO V WILKENS (PRESCRIPTIVE RIGHT TO MAINTAIN DAM).
For primary bibliographic entry see Field 06E.
W71-00891

FLOOD PLAIN INFORMATION, BRUSH CREEK, NORTH HUNTINGDON TOWNSHIP, PENNSYLVANIA.
Corps of Engineers, Pittsburgh, Pa.

Corps of Engineers Flood Plain Report, October 1969. 42 p, 13 fig, 9 plate, 10 tab.

Descriptors: *Floods, *Flood danage, Pennsylvania, Flood plains Regional flood, Flood forecasting, Flood control, Streamflow, Flow measurement, Bridges.
Identifiers: *Flood records, Standard project flood, Intermediate regional flood.

Flooding along Brush Creek within the limits of North Huntingdon Township and the Borough of Irwin in Westmoreland County, Pennsylvania is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections, and text material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. (Woodard-USGS)
W71-00892

ANNUAL REPORT OF PHREATOPHYTE ACTIVITIES - 1968,
Bureau of Reclamation, Denver, Colo. Office of Chief Engineer.
For primary bibliographic entry see Field 03B.
W71-00911

YORK V GOLDER (EXISTENCE OF A DRAINAGE EASEMENT OF NECESSITY).
For primary bibliographic entry see Field 06E.
W71-00914

GODDARD V BERLIN MILLS CO (LIABILITY FOR FLOODING CAUSED BY BACKWATER FROM DAM).
For primary bibliographic entry see Field 06E.
W71-00938

ALEXANDER V WABASH RY (LIABILITY FOR OBSTRUCTION OF SURFACE RUNOFF).
For primary bibliographic entry see Field 06E.
W71-00965

CHICAGO, ST LOUIS AND NEW ORLEANS RR V ADKINS (LIABILITY FOR OBSTRUCTION TO FLOW DUE TO INSUFFICIENT PASSAGE IN RAILROAD EMBANKMENT).
For primary bibliographic entry see Field 06E.
W71-00966

CHESAPEAKE AND O RY V STEPHENS (FLOODING CAUSED BY OBSTRUCTION OF CULVERT UNDER RAILROAD).
For primary bibliographic entry see Field 06E.
W71-00967

FUNKE V ST LOUIS - SAN FRANCISCO RY (LIABILITY FOR DISCHARGE OF SURFACE WATER COLLECTED IN DITCH.
For primary bibliographic entry see Field 06E.
W71-00969

CHESAPEAKE AND O RY V CLIFTON (LIABILITY FOR FLOODING CAUSED BY OBSTRUCTION OF CULVERT UNDER RAILROAD).
For primary bibliographic entry see Field 06E.
W71-00970

CAVITT V FOWLER (OWNER MAY CONSTRUCT DAM AND DITCH ON OWN LAND TO RECLAIM LAND).
For primary bibliographic entry see Field 06E.
W71-00971

TIDE WATER OIL SALES CORP V SHIMELMAN (LIABILITY FOR INTERFERENCE WITH DRAINAGE OF SURFACE WATER).
For primary bibliographic entry see Field 06E.
W71-00973

MISSOURI PAC RR V NICHOLS (RAILROAD FAILING TO PROVIDE OPENINGS IN EMBANKMENTS LIABLE FOR FLOODING LANDS).
For primary bibliographic entry see Field 06E.
W71-00974

COZY LAKE, INC V NYODA GIRL'S CAMP INC (RIPARIAN RIGHT TO NATURAL FLOW OF A STREAM).
For primary bibliographic entry see Field 06E.
W71-00977

HENDRIX V MCEACHERN (LIABILITY FOR OBSTRUCTION OF NATURAL DRAINAGE OF UPPER LAND).
For primary bibliographic entry see Field 06E.
W71-00980

VIRGINIA HOT SPRINGS CO V HOOVER (LIABILITY FOR DIVERSION OF SPRING WATERS).
For primary bibliographic entry see Field 06E.
W71-00982

DEL BALSO HOLDING CORP V MCKENZIE (OWNERSHIP OF UPLAND AND RIPARIAN RIGHTS).
For primary bibliographic entry see Field 06E.
W71-00983

PLACE V UNION TOWNSHIP (MUNICIPAL LIABILITY FOR ALTERATION OF NATURAL DRAINAGE).
For primary bibliographic entry see Field 06E.
W71-00985

MOBILE AND O RR V TAYS (LIABILITY FOR ALTERATION OF SURFACE WATER FLOW BY CONSTRUCTION OF RAILROAD EMBANKMENT).
For primary bibliographic entry see Field 06E.
W71-00986

SMITH V MCELDERRY (RIPARIAN OWNER'S LIABILITY FOR DIVERSION AND ALTERATION OF NATURAL FLOW OF STREAM).
For primary bibliographic entry see Field 06E.
W71-00989

JAMES V HAMM (LIABILITY FOR FLOOD DAMAGE CAUSED BY CONSTRUCTION OF DITCHES).
For primary bibliographic entry see Field 06E.
W71-00992

WHITE CONST CO V BROOKS (LIABILITY FOR OBSTRUCTION OF STREAM ALLEGED TO HAVE CAUSED FLOOD DAMAGE).
For primary bibliographic entry see Field 06E.
W71-00994

MACLEOD V DAVIS (PRESCRIPTIVE RIGHT TO USE SEWER DRAIN).
For primary bibliographic entry see Field 06E.
W71-00998

HEINE V BANDELIER (DAMAGE FROM IMPROPER DRAINAGE PRACTICE).
For primary bibliographic entry see Field 06E.
W71-00999

WHITLING V TYLER (EQUITABLE RELIEF FROM OBSTRUCTION TO FLOW).
For primary bibliographic entry see Field 06E.
W71-01001

MCKIERNANN V GRIMM (OBSTRUCTION OF NATURAL WATERCOURSE).
For primary bibliographic entry see Field 06E.
W71-01002

SICILIANO V BARBUTO (DISCHARGE OF COLLECTED WATER).
For primary bibliographic entry see Field 06E.
W71-01003

HOLTON V NORTHWESTERN OIL CO (SURFACE WATER DRAINAGE AS NUISANCE).
For primary bibliographic entry see Field 06E.
W71-01006

CHESAPEAKE AND O RY V CALDWELL (LIABILITY FOR DAMAGES RESULTING FROM INSUFFICIENT DRAINAGE THROUGH RAILWAY EMBANKMENT).
For primary bibliographic entry see Field 06E.
W71-01008

JOHNSON V CHICAGO B AND Q RR (WAIVER OF RIGHT TO DAMAGES CAUSED BY OBSTRUCTION TO FLOW OF NATURAL DRAIN).
For primary bibliographic entry see Field 06E.
W71-01012

NORDLUM V GREAT NORTHERN RY (ALTERATION OF NATURAL COURSE OF DRAINAGE WATER BY RAILROAD BED CONSTRUCTION).
For primary bibliographic entry see Field 06E.
W71-01014

HICKEL V CHICAGO R I AND P RY (ALTERATION OF NATURAL COURSE OF DRAINAGE).
For primary bibliographic entry see Field 06E.
W71-01015

DALY V STATE (EXTRAORDINARY RAINFALL IS NO DEFENSE TO NEGLIGENCE IN MAINTAINING A CANAL).
For primary bibliographic entry see Field 06E.
W71-01018

COUCH V CLINCHFIELD COAL CORP (COAL COMPANY'S LIABILITY FOR DIVERTING FLOW OF PERCOLATING WATER).
For primary bibliographic entry see Field 06E.
W71-01022

MCNABB V HOUSER (DIVERSION OF WATER FROM A NON-NAVIGABLE STREAM).
For primary bibliographic entry see Field 06E.
W71-01024

DRUCE V BLANCHARD (NATURAL FLOW OF DRAINAGE CREATES EASEMENT).
For primary bibliographic entry see Field 06E.
W71-01030

MADDOCK V CITY OF SPRINGFIELD (FLOODING BY SURFACE WATER DRAINAGE).
For primary bibliographic entry see Field 06E.
W71-01032

KUNKLE V BOROUGH OF FORD CITY (OBSTRUCTION TO FLOW OF SWAMP DRAINAGE).
For primary bibliographic entry see Field 06E.
W71-01040

HENDRIX V ROBERTS MARBLE CO (RIPARIAN RIGHTS LIMITED TO RIPARIAN LAND).
For primary bibliographic entry see Field 06E.
W71-01045

FACKLER V CINCINNATI NO AND TP CO (PROOF OF DAMAGES REQUIRED IN ORDER TO ENFORCE COVENANT NOT TO OBSTRUCT NATURAL STREAMFLOW).
For primary bibliographic entry see Field 06E.
W71-01048

SQUAW ISLAND FREIGHT TERMINAL CO V UNITED STATES (DAMAGES TO ISLAND FROM FAILURE TO MAINTAIN DIKE).
For primary bibliographic entry see Field 06E.
W71-01049

NORTHWEST RR V UNITED STATES (STRUCTURES ERECTED IN BED OF NAVIGABLE STREAM SUBJECT TO DESTRUCTION WITHOUT REMEDY BY UNITED STATES IN AID OF NAVIGATION.
For primary bibliographic entry see Field 06E.
W71-01051

TRANSIENT FLOW BETWEEN PARALLEL DRAINS,
California Univ., Los Angeles; and San Jose State Coll., Calif.
William Wen-Gong Yeh, and Rameshwar Singh.
Journal of Hydrology, Vol 11, No 3, p 301-312, September 1970. 12 p, 12 fig, 1 tab, 7 ref.

Descriptors: *Subsurface drainage, *Unsteady flow, *Groundwater movement, *Mathematical studies, *Computer programs, Linear programming, Soil water movement, Drainage systems, Hydraulic conductivity, Specific yield, Dupuit-Forchheimer theory, Permeability, Drawdown.
Identifiers: Transient groundwater flow.

The problem of transient-flow subsurface drainage between parallel drains has been solved by the method of weighted-residuals. The assumption of an initial profile is removed in this method. The governing nonlinear partial differential equation is reduced to ordinary differential equations which are easily solvable on the computer. The solution is presented in two nondimensional graphical forms for easy field application. (Knapp-USGS)
W71-01063

RAU V URBAN (LIABILITY FOR PREDECESSOR'S IN TITLE ACTS).
For primary bibliographic entry see Field 06E.
W71-01075

O'NEAL V ROLLINSON (RIPARIAN RIGHTS EXTEND PERPENDICULAR TO LAND).
For primary bibliographic entry see Field 06E.
W71-01078

FITZSIMMONS V CASSITY (OWNER OF LAND TAKEN BY RIVER RECEIVES TITLE TO OLD RIVER BED).
For primary bibliographic entry see Field 06E.
W71-01079

FITZGERALD V FORTIER (LIABILITY FOR OBSTRUCTION OF WATERCOURSES).
For primary bibliographic entry see Field 02E.
W71-01082

FOSTER V MALSBURY (INJUNCTIVE RELIEF FOR OBSTRUCTION OF WATERCOURSE).
For primary bibliographic entry see Field 06E.
W71-01083

SCHWARTZ V WAPELLO COUNTY (PUBLIC RIGHTS TO NATURAL DRAINAGE).
For primary bibliographic entry see Field 06E.
W71-01084

FLOOD PLAIN INFORMATION OF LICKING RIVER, CAMPBELL AND KENTON COUNTIES, KENTUCKY.
Corps of Engineers, Louisville, Ky.

Corps of Engineers Flood Plain Report, December 1968. 34 p, 7 fig, 11 plate, 6 tab.

Descriptors: *Floods, *Flood damage, *Kentucky, Flood plains, Regional flood, Flood forecasting, Flood control.
Identifiers: *Flood records, *Licking River (Campbell and Kenton Counties, Ky), Standard project flood, Intermediate regional flood.

Flooding along the Licking River in Campbell and Kenton Counties, Kentucky is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections, and text material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. (Woodard-USGS)
W71-01095

FLOOD PLAIN INFORMATION STUDY, PIGEON CREEK, VANDERBURGH COUNTY, INDIANA - MAIN REPORT.
Corps of Engineers, Louisville, Ky.

Corps of Engineers Flood Plain Report, May 1967. 36 p, 9 fig, 4 plate, 5 tab, 13 ref.

Descriptors: *Floods, *Flood damage, *Indiana, Flood plains, Regional flood, Flood forecasting, Flood control.
Identifiers: *Flood records, Flood frequencies, Standard project flood, Intermediate regional flood.

Flooding along Pigeon Creek in Vanderburgh County, Indiana is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections, and text material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. (Woodard-USGS)
W71-01096

4B. Groundwater Management

LAND SUBSIDENCE RELATED TO DECLINE OF ARTESIAN HEAD AT BATON ROUGE, LOWER MISSISSIPPI VALLEY, U. S. A.,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02F.
W71-00563

NEED FOR SALINE GROUNDWATER DATA TO ADVANCE DESALTING TECHNOLOGY,
Office of Saline Water, Washington, D.C.
For primary bibliographic entry see Field 03A.
W71-00570

ACQUISITION AND MACHINE PROCESSING OF SALINE WATER DATA FROM SOUTHEASTERN NEW MEXICO AND WESTERN TEXAS,
Geological Survey, Albuquerque, N. Mex.
For primary bibliographic entry see Field 07C.
W71-00572

DEEP WELL DISPOSAL OF WASTE WATERS IN SALINE AQUIFERS OF SOUTH FLORIDA,
Black, Crow and Eidsness, Inc., Gainesville, Fla.; and Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 05E.
W71-00573

PLAYA WATER QUALITY CHANGES WITH TIME AND EFFECTS ON CLARIFICATION,
Agricultural Research Service, Bushland, Tex. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02K.
W71-00578

FLUID TRAVEL TIME BETWEEN A RECHARGING AND DISCHARGING WELL PAIR IN AN AQUIFER HAVING A UNIFORM REGIONAL FLOW FIELD,
Geological Survey, Denver, Colo. Water Resources Div.
For primary bibliographic entry see Field 02F.
W71-00581

DOES ARTIFICIAL GROUNDWATER RECHARGE CONTAMINATE OUR GROUNDWATERS,
Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering; Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 05B.
W71-00628

THE DESIGN OF AN EXPERIMENTAL ARTIFICIAL RECHARGE WELL AT TUCSON, ARIZONA,
Arizona Water Resources Research Center, Tucson.
L. G. Wilson, M. M. Fogel, K. J. DeCook, and P. S. Osborne.
Annals of Arid Zone, Vol 8, No 2, p 267-274, September 1969. 1 fig, 8 ref. OSW Contract 14-01-0001-630.

Descriptors: *Artificial recharge, *Recharge wells, *Groundwater recharge, *Water conservation, *Hydrogeology, Sedimentary basins (Geological), Alluvium, Ephemeral streams, Effluents, On-site tests, Arid lands, Arizona, Wells, Pumping, Withdrawal, Design, Injection wells, Equipment, Subsurface flow.
Identifiers: Tucson (Arizona).

Tucson, Arizona, obtains its entire water supply by pumping groundwater. Recharge occurs during influent seepage in ephemeral rivers, but it is lagging behind withdrawal and water levels are dropping at a rate of about 1 meter per year. Artificial well recharge appears to be the best regional water conservation mechanism. In designing an artificial recharge well, it is important to investigate subsurface materials at the proposed site. Driller's logs were examined, a water supply well and 3 observation wells were drilled, geophysical exploration techniques were utilized and subsurface flow characteristics determined. Since the materials in the vadose zone were found to be highly permeable, a dual recharge well was constructed for recharge of the unsaturated region as well as the phreatic zone. The design and operation of the well are described in detail. Injected water was industrial effluent from a nearby power plant. Recharge tests showed injection rates ranging over 23-102 cubic meters per hour. Such wells may be effective tools for water conservation in the Tucson Basin. (Casey-Arizona)
W71-00691

DETERMINISTIC LINEAR HYDROLOGIC SYSTEMS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06A.
W71-00728

USE OF ANALOG COMPUTER IN GROUNDWATER HYDROLOGY,
Minnesota Univ., Minneapolis. Water Resources Research Center.
William C. Walton.
Progress of Hydrology, Vol I, pp 265-289, July 1969. 25 p, 8 fig, 11 ref.

Descriptors: *Analog Computers, *Aquifers, Hydrology, Groundwater, Analytical techniques, Missouri River.

A complete description of the Analog computer generally consisting of an analog made and excitation-response apparatus, i.e., a waveform generator, pulse generator, and oscilloscope, was presented. The analog model described was a regular array of resistors and capacitors, and was a caled down version of the aquifer. An analogy was drawn between electrical systems and aquifer systems. The excitation-response apparatus was illustrated. An investigation made by the Saskatchewan Research Council from 1964 to 1966 to determine the nature and extent of sand and gravel aquifers in the buried Missouri River Valley system in the vicinity of Estevan,

Saskatchewan, Canada and to estimate the potential yield of the aquifers with selected schemes of development was given as a case history of the use of an analog computer. The investigation included collection and analysis of water-level data to define the piezometric surfaces of the aquifers and associated deposits and the data on the chemical character of the groundwaters, an extensive test-hole drilling program, controlled aquifer and well production tests, and an analog computer study. The reach of the buried Missouri River Valley system west, east and north of Estevan was considered. (Kriss-Cornell)
W71-00732

GROUNDWATER UTILIZATION: STUDY OF METHODS, WITH ENGINEERING ANALYSIS,
Hydro Research Science, Sunnyvale, Calif.
Alexander B. Rudavsky.
Available from the NTIS as AD-858 430, $3.00 in paper copy, $0.95 in microfiche. September 13, 1969. 42 p.
Identifiers: *Water, Underground, *Water supplies, *Drilling, *Water wells, *Bibliographies, *Drilling machines, Reviews, Test methods, Industrial production, Army operations, Military engineering, Catalogs, Groundwater, Potable water.

The objective of the report is to summarize known well-construction techniques for obtaining groundwater during military field operations. A considerable number of references on drilling methods and equipment exist in multi-language literature. The literature study shows considerable completed research for developing bottom hole drilling methods. There has been much study on the conventional application of turbodrills in Russia. Considerable efforts have also been spent to improve present drilling tools and systems in order to reduce drilling costs. The review of manufacturer's catalogs, leaflets, descriptive literature, and other printed matter on off-shelf items for the well drilling industry indicates very few radical changes in drilling concepts but a trend of the industry to improve the drilling techniques and well construction.
W71-00783

HYDROLOGY OF PROJECT GASBUGGY SITE, RIO ARRIBA COUNTY, NEW MEXICO,
Geological Survey, Denver, Colo.
Jerry W. Mercer.
Available from NTIS as PNE-1013, $3.00 in paper copy, $0.95 in microfiche. Atomic Energy Commission Project Gasbuggy Peaceful Nuclear Explosions Report PNE-1013 (TID-4500), March 6, 1970. 45 p, 12 fig, 4 tab, 4 ref.

Descriptors: Hydrology, *Nuclear explosions, *Underground, *New Mexico, Groundwater, Aquifers, Transmissivity, Aquifer characteristics, Water wells, Discharge measurement, Water quality, Hydrologic data, Geology, Sandstones, Draindown, Equations, Chemical analysis, Pollutants.
Identifiers: *Ojo Alamo Sandstone, Exploratory holes.

The Project Gasbuggy nuclear experiment of 26 kilotons design yield was detonated at 4,240 feet below ground surface at the Gasbuggy site in Rio Arriba County, New Mexico on December 10, 1967. The experiment was designed to increase the permeability of a low-yield natural gas formation. The Ojo Alamo Sandstone reportedly was the only aquifer within probable range of fracturing at the site. Thus, hydrologic testing in the exploratory holes was in that sandstone between approximate depths of 3,475 and 3,650 feet. Data indicated that if the nuclear detonation fractured the Ojo Alamo Sandstone, water from this sandstone would fill the chimney or detonation chamber at an estimated rate of less than half a foot per day. The low transmissivity of the sandstone aquifer would hinder the transport of radioactive contaminants in water in the aquifer, even if momentary overpressure in the explosion cavity caused contaminants to reach the Ojo Alamo Sandstone. Observation of water levels in wells and measurements of yields of springs prehot, at shot time, and postshot indicate that the detonation did not significantly or permanently disturb nearly water wells or springs. (Woodard-USGS)
W71-00810

OPTIMIZING CONJUNCTIVE USE OF GROUNDWATER AND SURFACE WATER,
Utah Water Research Lab., Logan.
James H. Milligan.
Available from NTIS as PB-192 712, $3.00 in paper copy, $0.95 in microfiche. June 1970. 160 p. PRWG 42-4T.
Identifiers: *Management planning, Hydrology, *Water supplies, *Utah, Mathematical models, Programming (Computers), Stochastic processes, Linear programming, Rivers, Design, Probability, Optimization, Storage, Costs, Theses, *Groundwater, *Water management, Computerized simulation, Surface water runoff.

The determination of optimal allocations of surface water and groundwater resources that will accomplish the objective of economic efficiency as measured by maximizing net benefits is the basic objective of the several models developed and described in this report. The mathematical procedure used for optimizing the water resource allocations in this fashion makes use of several algorithms of linear programming as available on a Univac 1108 digital computer. Each of the solutions derived from the models presented is analyzed in order to evaluate the optimization procedure. Models are formulated for one hypothetical hydrologic unit or basin and for two real river basins. The real river basins were used to test the viability of the modeling procedure and to evolve a practical methodology.
W71-00816

FRESHWATER BUBBLES: A POSSIBILITY FOR USING SALINE AQUIFERS TO STORE WATER,
Geological Survey, Denver, Colo.
E. A. Moulder.
Water Resources Research, Vol 6, No 5, p 1528-1531, October 1970. 4 p, 3 fig, 1 tab, 8 ref.

Descriptors: *Water storage, *Reviews, *Underground storage, *Saline water systems, *Water resources development, Aquifers, Saline water, Groundwater movement, Mixing, Dispersion, Diffusion, Flow, Water management (Applied), Conjunctive use.
Identifiers: Saline water resources, Saline aquifers.

Saline aquifers appear to have promising storage capabilities for freshwater supplies. Such aquifers would be a practical alternative to surface water reservoirs in areas where natural reservoir sites are scarce or where evaporation might consume a substantial part of the water stored. A single experiment in Virginia more than 20 years ago shows that a substantial amount of freshwater injected into the saline aquifer can be recovered. Environmental factors that affect water recovery are dispersion and mixing at the fresh-saline water interface, reshaping of the interface because of density differences of the fluids, and groundwater movement in the saline aquifer system. Mathematical approaches to estimating these factors are reviewed. Feasibility studies of storage facilities should include evaluation of at least these three factors. (Knapp-USGS)
W71-00836

DESALTING SALINE GROUNDWATER FOR IRRIGATION: A CASE STUDY, BUCKEYE, ARIZONA,
Bureau of Reclamation, Denver, Colo.; and Office of Saline Water, Washington, D.C.
For primary bibliographic entry see Field 03A.
W71-00837

FLUID MODEL STUDIES OF THE STORAGE OF FRESHWATER IN SALINE AQUIFERS,
Louisiana State Univ., Baton Rouge.
Oscar R. Kimbler.
Water Resources Research, Vol 6, No 5, p 1522-1527, October 1970. 6 p, 4 fig, 4 ref.

Descriptors: *Hydraulic models, *Underground storage, *Artificial recharge, *Saline water systems, Injection wells, Model studies, Mixing, Withdrawal, Dispersion, Diffusion, Conjunctive use, Water resources development, Aquifers.
Identifiers: Saline aquifers, Saline water resources.

Flow studies in artificial sandstone models were used to test and validate a computational technique for predicting the recovery of freshwater stored in saline aquifers. These studies indicate the physical and operational conditions under which such storage should be technically feasible, and show that gravitational effects are usually a much more important cause of poor freshwater recovery than is dispersion. (Knapp-USGS)
W71-00838

STORAGE OF NATURAL GAS IN SALINE AQUIFERS,
Michigan Univ., Ann Arbor.
Donald L. Katz, and M. Rasin Tek.
Water Resources Research, Vol 6, No 5, p 1515-1521, October 1970. 7 p, 9 fig, 2 tab, 8 ref.

Descriptors: *Underground storage, *Aquifers, *Reviews, *Saline water systems, *Natural gas, Water resources development, Injection wells, Oil fields, Oil reservoirs, Injection.
Identifiers: Saline aquifers.

Value, extent, and engineering description of underground storage of natural gas in saline aquifers are reviewed. Problems associated with evaluation of aquifer storage prospects, geologic and geochemical requirements have been discussed along with topics related to operating pressures, gas retention, and pump tests. (Knapp-USGS)
W71-00839

REDUCING LAND SUBSIDENCE IN THE WILMINGTON OIL FIELD BY USE OF SALINE WATERS,
Long Beach Dept. of Oil Properties, Calif.
Robert L. Pierce.
Water Resources Research, Vol 6, No 5, p 1505-1514, October 1970. 10 p, 9 fig.

Descriptors: *Injection wells, *Oil fields, *Land subsidence, *California, *Withdrawal, Secondary recovery (Oil), Flooding, Oil wastes, Water treatment, Brine disposal.
Identifiers: Subsidence control, Long Beach (Cal).

The subsidence at Long Beach encompassed an area of 22 square miles; sinkage ranges from 2 feet to 30 feet. The subsidence is attributed to pressure reduction due to oil production from the Wilmington oil field. Injection of saline water stopped the Long Beach harbor area subsidence and has developed a technology for an economic waterflood project. Through December 1968, 2.1 billion barrels of saline water have been injected into the Wilmington oil field. The current injection rate of the field is 1.1 million barrels per day. The methods being used to clean the oil field's produced brine include: (1) filtration, (2) re-cycling through the shallow source water beds, and (3) blending with fresh or other saline waters. (Knapp-USGS)
W71-00840

WATER POLLUTION CONTROL CREATES DEMAND FOR GROUNDWATER HYDROLOGISTS,
Geological Survey, Denver, Colo. Water Resources Div.
For primary bibliographic entry see Field 05G.
W71-00848

REPORT ON GEOPHYSICAL AND TELEVISION EXPLORATIONS IN CITY OF JACKSONVILLE WATER WELLS,
Geological Survey, Tallahassee, Fla.
G. W. Leve.
Florida Bureau of Geology Information Circular No 64, 1970. 15 p, 9 fig, 1 tab.

Descriptors: *Water wells, *Groundwater, *Telemetry, *Borehole geophysics, *Surveys, *Water supply, Aquifers, Petrography, Gamma rays, Geomorphology, Borehole cameras, Subsurface investigations, Electrical resistivity, Electrical properties.
Identifiers: *Television surveys (Water wells), Aquifer evaluation.

During November 1968, eight water production wells for the city of Jacksonville, Fla. were examined for physical condition and further information on the hydrologic properties of the aquifer. The data were collected from electric logs, gamma logs, caliper logs, current meter traverses, and television traverses, and are presented as part of a comprehensive investigation to fully appraise the water resources in the Jacksonville area. (Woodard-USGS)
W71-00849

COMPREHENSIVE PLANNING STUDY OF THE GRAND RIVER BASIN, MICHIGAN--APPENDIX E.
Geological Survey, Lansing, Mich.
For primary bibliographic entry see Field 02F.
W71-00851

PRELIMINARY EVALUATION OF AVAILABILITY OF POTABLE WATER ON ELLIOTT KEY, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 03B.
W71-00881

GEOLOGY AND GROUNDWATER RESOURCES OF THE ASHEVILLE AREA, NORTH CAROLINA,
Geological Survey, Raleigh, N.C.
For primary bibliographic entry see Field 02F.
W71-00903

MINING WATER IN IRAN,
Utah State Univ., Logan. Dept. of Agricultural Economics.
Allen LeBaron, and Malek Mohtadi.
Utah Science, Utah Agricultural Experiment Station, Utah State University, September 1968, Vol 29, No 3, p 88-89, 92, 2 fig.

Descriptors: *Groundwater supply, *Irrigation wells, *Arid lands, *Groundwater mining, *Water harvesting, Social aspects, Shafts (Excavations), Tunnel construction, Cost comparisons, Irrigation systems, Water reuse, Canals, Wells, Runoff.
Identifiers: *Ghanats, *Moghanis, *Horizontal wells, *Underground infiltration tunnels, Well development, Iran.

Ghanats (underground infiltration tunnels or horizontal wells) are an important water source in Southwest Asia and North Africa. From 1/3 to 3/4 of all irrigation in Iran is supplied by ghanats. They capture rainwater which runs quickly off mountains and seeps into alluvial fans. A mother well is evcavated and the water flows to the surface by a gently sloping tunnel, then travels by open canal. The underground ghanat is marked by shafts used to lift earth during construction and to facilitate maintenance. The average ghanat is 150 feet deep and over 2 miles long. A long ghanat may have several hundred shafts. Seepage from irrigated fields is sometimes recollected and passed on to another ghanat. Water ownership is the deciding factor in land settlement. For aesthetic, mechanical and supply reasons, mills and residences are located near ghanats. Costs of ghanats may be favorable compared to drilled wells utilizing petroleum. Workers called 'Moghanis' specialize in ghanat excavation and maintenance--a family occupation passed through generations. Although there are hazards of falling stones, collapsing roofs, asphyxiation and drowning, there are from 20,000 to 40,000 Moghanis. A typical cross-section and areal route of an Iranian ghanat are shown in the article. (Popkin-Arizona)
W71-00958

RECHARGING THE OGALLALA FORMATION USING SHALLOW HOLES,
Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering.
Marvin Dvoracek, and Sam H. Peterson.
Texas Tech Univ Contribution No 78, Paper Presented at Ogallala Aquifer Symposium, Texas Tech Univ, Lubbock, April 30-May 1, 1970. 18 p, 7 fig, 1 tab, 15 ref. OWRR Project B-041-Tex.

Descriptors: *Artificial recharge, *Injection wells, *Unsaturated flow, Water levels, Infiltration, Water table, Water level fluctuations, Percolation, Permeability, Caliche, Alluvium.
Identifiers: Ogallala aquifer, Shallow recharge wells.

Natural groundwater recharge cannot sustain the Southern High Plains portion of the Ogallala Formation. Nearly all the water used in this region is derived from the Ogallala Formation. The southern part of the Ogallala is hydrologically isolated from all outside areas; natural recharge to this portion of the aquifer originates only form precipitation falling on the aquifer. The region has only limited and erratic rainfall, poorly established drainage, and very few lakes or reservoirs; therefore, it offers little opportunity for natural recharge. The volume of water withdrawn, as shown by the water level decline, is many times greater than the estimated natural recharge of about 1 inch per year. In tests, more than 15 acre-feet of runoff water was recharged in shallow holes completed above the water table. Increases in rate of recharge were observed during the tests. A condition of soil piping is probably responsible for the increasing rates and loss of material from cavities near the recharge wells. (Knapp-USGS)
W71-01058

TAUNTON RIVER BASIN-MASSACHUSETTS BASIC-DATA REPORT NO. 12, GROUNDWATER SERIES,
Geological Survey, Boston, Mass.
John R. Williams, and Richard E. Willey.
US Geological Survey Open-file report, 1970. 102 p, 1 fig, 1 plate, 5 tab, 4 ref.

Descriptors: *Hydrologic data, *Water wells, Massachusetts, *Groundwater, *Water levels, Water quality, Aquifers, Water resources, Water resources development, Water yield, Observation wells, Sampling, Hydrogeology, Data collections.
Identifiers: Taunton basin (Mass).

This report presents in tabular form selected records of wells, test wells, and borings collected during a study of the Taunton basin from 1966 to 1968 in cooperation with the Massachusetts Water Resources Commission, and during earlier studies. The public and local, state, and federal agencies may use this basic groundwater information that may aid in planning water-resources development. Data on 2,059 selected wells, test wells, and borings, including United States Geological Survey auger borings, Massachusetts Department of Public Works bridge and roadway borings, and miscellaneous foundation borings are tabulated. Chemical and partial chemical analyses are given of the water from 137 wells. Water level measurements in 11 observation wells are presented as hydrographs. (Knapp-USGS)
W71-01089

MULTIVARIATE ANALYSIS IN GROUNDWATER HYDROLOGY -- THEORY,
California State Coll., Long Beach. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02F.
W71-01098

4C. Effects on Water of Man's Non-Water Activities

MODELING THE EFFECT OF LAND USE MODIFICATIONS ON RUNOFF,
Agricultural Research Service, Brookings, S. Dak.; and Water Resources Board, Reading (England).
C. A. Onstad, and D. G. Jamieson.
Water Resources Research, Vol 6, No 5, p 1287-1295, October 1970. 9 p, 9 fig, 8 tab, 6 ref.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Precipitation excess, *Parametric hydrology, Simulation analysis, Routing, Synthetic hydrology, Runoff forecasting, Land use, Land management, Hydrograph analysis, Optimization, Flood control, Soil conservation.
Identifiers: *Runoff management.

The natural apportionment of rainfall excess to surface and subsurface flow can mean the difference between large flow rates for a short time or more manageable flow rates over a longer time. By using available soil storage, peak flood flows can be reduced without necessarily reducing the total volume of runoff. A model was made to simulate this phenomenon. The land phase of the hydrologic system was simulated by a series of interconnected, nonlinear reservoirs and the channel phase by a single linear reservoir. By manipulation of parameters, which mathematically represent physical measurements, the watershed response to the addition of conservation practices, such as terracing, may be predicted. (Knapp-USGS)
W71-00589

THE MEASUREMENT OF THE EFFECTS OF BUILDING CONSTRUCTION ON DRAINAGE BASIN DYNAMICS,
Exeter Univ. (England).
D. E. Walling, and K. J. Gregory.
Journal of Hydrology, Vol 11, No 2, p 129-144, August 1970. 16 p, 8 fig, 21 ref.

Descriptors: *Construction, *Urbanization, *Sediment yield, *Storm runoff, Rainfall-runoff relationships, Hydrograph analysis, Erosion, Soil erosion, Regression analysis, Peak discharge, Stage-discharge relations.
Identifiers: Urban hydrology.

The magnitude of the impact of building activity upon suspended sediment concentrations may be assessed by comparing samples obtained simultaneously at different points within one catchment or by comparing samples derived from two adjacent small watersheds, one of which serves as a control. In each case the suspended sediment concentrations are between 2 and 10 times, and occasionally up to 100 times, greater than the concentrations obtained from undisturbed conditions. The form of the relationships obtained demonstrates the importance of variable source areas within the catchments. To assess the yields over time, streamflow and sediment records are required. A small catchment has been instrumented for this purpose on the margin of Exeter, Devon, England. The catchment was calibrated for a period of 17 months prior to building activity by deriving multiple regression equations relating peak flow, runoff amount and runoff percentage to precipitation characteristics at different times of the year, by evaluating unit hydrographs, by establishing suspended sediment rating curves, and by using two adjacent catchments as controls. (Knapp-USGS)
W71-00592

STORM WATER POLLUTION FROM URBAN LAND ACTIVITY, DEVELOPMENT OF ANALYTICAL PROCEDURES FOR PREDICTING STORM WATER POLLUTION FROM URBAN AREAS BY USE OF SELECTIVELY DEFINED URBAN CHARACTERISTICS.
Avco Economic Systems Corp., Washington, D.C.
For primary bibliographic entry see Field 05A.
W71-00619

AMITROLE RESIDUES AND RATE OF DISSIPATION IN IRRIGATION WATER,
Agricultural Research Service, Denver, Colo. Crops Research Div.; and Agricultural Research Service, Prosser, Wash. Crops Research Div.
For primary bibliographic entry see Field 03F.
W71-00698

SOUTHERN RY V NEAL (RAILROAD'S LIABILITY FOR FLOODING CAUSED BY INADEQUATE CULVERT).
For primary bibliographic entry see Field 06E.
W71-00760

INITIAL ENVIRONMENTAL STUDY.
Erie and Niagara Counties Regional Planning Board, Grand Island, N.Y.
For primary bibliographic entry see Field 06G.
W71-00785

MINING WATER IN IRAN,
Utah State Univ., Logan. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 04B.
W71-00958

ALEXANDER V WABASH RY (LIABILITY FOR OBSTRUCTION OF SURFACE RUNOFF).
For primary bibliographic entry see Field 06E.
W71-00965

CHICAGO, ST LOUIS AND NEW ORLEANS RR V ADKINS (LIABILITY FOR OBSTRUCTION TO FLOW DUE TO INSUFFICIENT PASSAGE IN RAILROAD EMBANKMENT).
For primary bibliographic entry see Field 06E.
W71-00966

CHESAPEAKE AND O RY V STEPHENS (FLOODING CAUSED BY OBSTRUCTION OF CULVERT UNDER RAILROAD).
For primary bibliographic entry see Field 06E.
W71-00967

FUNKE V ST LOUIS - SAN FRANCISCO RY (LIABILITY FOR DISCHARGE OF SURFACE WATER COLLECTED IN DITCH.
For primary bibliographic entry see Field 06E.
W71-00969

CHESAPEAKE AND O RY V CLIFTON (LIABILITY FOR FLOODING CAUSED BY OBSTRUCTION OF CULVERT UNDER RAILROAD).
For primary bibliographic entry see Field 06E.
W71-00970

MISSOURI PAC RR V NICHOLS (RAILROAD FAILING TO PROVIDE OPENINGS IN EMBANKMENTS LIABLE FOR FLOODING LANDS).
For primary bibliographic entry see Field 06E.
W71-00974

LUTESVILLE SAND AND GRAVEL CO V MCLAUGHLIN (OWNERSHIP OF SANDBAR IN NAVIGABLE STREAM).
For primary bibliographic entry see Field 06E.
W71-00976

EASTON V STATE (AMOUNT OF COMPENSATION FOR TAKING OF LAND AND POLLUTING A STREAM).
For primary bibliographic entry see Field 06E.
W71-01073

LEITCH V SANITARY DISTRICT (RIPARIAN RIGHTS AND OBSTRUCTIONS TO NAVIGATION).
For primary bibliographic entry see Field 06E.
W71-01076

4D. Watershed Protection

A GEOMORPHIC APPROACH TO EROSION CONTROL IN SEMIARID REGIONS,
Colorado State Univ., Fort Collins. Dept. of Geology.
S. A. Schumm.
American Society of Agricultural Engineers Transactions, Vol 12, No 1, p 60-68, January-February, 1969. 9 p, 21 fig, 3 tab, 34 ref.

Descriptors: *Erosion control, *Semiarid climates, *Geomorphology, Sediment yield, Streamflow, Drainage systems, Hydrologic properties, Vegetation, Precipitation (Atmospheric), Topography, Slopes, Runoff, Geology, Channel morphology, Sands, Channel erosion, Drainage patterns (Geologic), Rainfall-runoff relationships.

Erosional and depositional phenomena from a geomorphic perspective are evaluated from about 10 years of research concerning semiarid landforms. Emphasis on the processes of landscape modification and a quantitative description of landforms has provided information on the origin of certain features, and a means of delineating critical areas of the landscape where conservation techniques should be most effective. Related pictures, tables, and graphs are included. (Woodard-USGS)
W71-00605

EROSION-CONTROL PROBLEMS AND PRACTICES ON NATIONAL FOREST LANDS,
Forest Service (USDA), Logan, Utah. Div. of Soil and Water Management.
S. L. Cuskelly.
American Society of Agricultural Engineers Transactions, Vol 12, No 1, p 69-70, 85, January-February, 1969. 3 p.

Descriptors: *Erosion control, *National forests, Vegetation, Watershed management, Runoff, Sediment yield, Precipitation (Atmospheric), Forests, Reclamation, Soil stabilization.
Identifiers: Artificial seeding, Restoration, National Forests.

This paper reviews some of the procedures and equipment used in the restoration of national forest watersheds since the days of the civilian conservation corps in the 1930's including contour trenching, contour furrowing, and streambank and gully stabilization. Problems that still confront us are emphasized such as in the intermountain region national forests there are about 1,380,000 acres of rangeland and 860,000 acres of critical watershed area in need of rehabilitation. There are 5,900 miles of road and 3,240 miles of streambank needing stabilization. As watershed values increase and demands for restoration (and for that matter, all uses and activities) become even greater, these problems must be solved. (Woodard-USGS)
W71-00606

EROSION PROBLEMS AND CONTROL PRACTICES ON FEDERAL DOMAIN LANDS,
Bureau of Land Management, Logan, Utah.
Myrvin E. Noble.
American Society of Agricultural Engineers Transactions, Vol 12, No 1, p 71-74, January-February, 1969. 4 p, 2 fig, 2 tab.

Descriptors: *Erosion control, *Federal Government, Natural resources, Runoff, Sediment yield, Precipitation (Atmospheric), Streamflow, Vegetation, Conservation.
Identifiers: Federal domain lands, Bureau of Land Management, Western states.

Some of the most severe soil loss problems in the United States occur on the 174 million acres of leftover public domain remnants located mostly in 10 western states. These are lands administered by the Bureau of Land Management (BLM). In addition, the bureau has jurisdiction over 278,000,000 acres in Alaska; but it is this residue in the western conterminous states, after decades of government-allowed land entries, grants, reservations, and withdrawals, that presents a picture of critical depletion. This report reviews the problems and objectives concerning the conservation of these lands. Related information is presented in tables and maps. (Woodard-USGS)
W71-00607

FOREST SERVICE RESEARCH IN EROSION CONTROL,
Forest Service (USDA), Ogden, Utah. Intermountain Forest and Range Experiment Station.
Otis L. Copeland.
American Society of Agricultural Engineers Transactions, Vol 12, No 1, p 75-79, January-February, 1969. 5 p, 8 fig, 1 tab, 21 ref.

Descriptors: *Erosion control, *Federal government, *Watershed management, Precipitation (Atmospheric), Runoff, Streamflow, Sediment yield, Floods, Soil stabilization, Vegetation, Forests, Range management.
Identifiers: Forest service research, National Forests.

Functions of the U.S. Forest Service relating to factors that affect erosion processes, erosion-prevention actions, and erosion-control practices in watershed management research are described. Specific projects directly studying soil erosion processes and control are as follows: (1) Intermountain Station - Streamflow regulation and sediment reduction in northern Rocky Mountain forests, Preventing of controlling accelerated erosion of unstable forest soils, and Watershed protection requirements and rehabilitation measures to reduce flood runoff, erosion, and sediment from deteriorated rangelands and grazed forested areas; (2) Pacific Northwest Station - Soil stabilization and runoff regulation in conifer watersheds in Washington and Oregon, Water-yield improvement and erosion control - mid-Columbia River basin forests, and Erosion and sediment reduction, Alaska coastal forests; (3) Pacific Southwest Station - Hydrologic analysis methods, Flood and sediment reduction in the coniferous timber zone of California, and Flood and sediment reduction in steep, unstable brushlands of the Southwest; and (4) Rocky Mountain Station - Water-yield improvement and erosion control for montane and subalpine forests and rangelands, Improvement of water yields and soil stabilization: Big Horn, Powder River, and the North Platte River basins, Watersheds rehabilitation to control erosion and sedimentation in the Southwest, and Improvement of water yields and soil stabilization in the Black Hills. As of April 30, 1967, forty-two active studies relating to soil erosion were being conducted by these 13 projects. (Woodard-USGS)
W71-00608

STUDY OF EROSION IN ROADSIDE DRAINAGE CHANNELS IN NORTH CAROLINA,
North Carolina State Univ., Raleigh. School of Engineering.
Michael Amein, and H. L. Chu.
Available from NTIS as PB-191 398, $3.00 in paper copy, $0.95 in microfiche. September 1969, 63 p. Appendix to Project ERD-110-68-4.
Identifiers: *Roads, Drainage, *Erosion, Roads, Site selection, Sampling, Soil mechanics, Stability,

Statistical data, North Carolina, Ditches, *Drainage channels.

As part of an effort to establish criteria for the design of roadside drainage channels, a survey of many sites was made along the North Carolina highways. The survey consisted of measurement of the size of the contributing surface areas to the drainage, the measurement of the channel slope, the measurement of the channel cross section, identification of the surface cover, identification of points of incipient and severe erosion, identification of the extent of erosion and finally, testing of the soil samples. The soil test included sieve analysis and determination of the Atterberg limits. In addition, the location of each test site was marked on an area map. The results of this survey have been used to develop guidelines for the design of roadside channels. From these guidelines, the designer can hopefully predict whether a particular roadside channel (earth or grass) will be resistant to erosion and remain stable or whether there is a greater probability for erosion. In the latter case the use of a more resistant surface treatment such as paving would be recommended. This Appendix contains data and information which were used in the study on roadside drainage channels.
W71-00806

RESPONSE UNITS FOR EVALUATING THE HYDROLOGIC PERFORMANCE OF RANGELAND WATERSHEDS,
Agricultural Research Service, Boise, Idaho. Northwest Watershed Research Center.
For primary bibliographic entry see Field 02G.
W71-00866

ORGANIZING FOR SOIL EROSION AND SEDIMENT CONTROL IN OUR NATIONS URBAN AREAS,
National Association of Counties Research Foundation, Washington, D.C.
For primary bibliographic entry see Field 05G.
W71-00877

RANGE RESOURCES AND WATERSHED MANAGEMENT--A NEED FOR RESEARCH,
Utah State Univ., Logan. Dept. of Range Science.
Gerald F. Gifford.
Utah Science, Utah Agricultural Experiment Station, Utah State University, September 1968, Vol 29, No 3, p 90-91, 2 fig.

Descriptors: *Watershed management, *Land management, *Range management, *Watersheds (Basins), *Optimization, Vegetation, Arid lands, Water conservation, Soil conservation, Precipitation (Atmospheric), Runoff, Overland flow, Utah, Sedimentation, Erosion, Rainfall-runoff relationships, Soil-water-plant relationships, Ranges, Alpine, Multiple purpose projects, Resource development, Research and development, Hydrologic aspects, Water loss, Water utilization, Climatic data.
Identifiers: *Watershed research, *Range-resources research, *Range resources, *Watershed optimization, Turbulent runoff, Plant-soil complexes.

An important function of rangelands is receipt and disposal of precipitation of high and low intensity. Because Utah has abundant range resources, condition and trend of high-and low-elevation vegetation and their soils are important in determining how such areas respond to rain and snow. Knowledge of precipitation and turbulent runoff (overland flow) is requisite to planning by resource managers. Questions arise concerning the occurrence, form, amount, distribution, frequency and modification of rainfall, and erosion, sedimentation, land deterioration, improvement practices, protection criteria, watershed treatment and field analysis. Watershed optimization includes management of (1) soil-cover maintence; (2) multiple range-improvement practices; (3) quantification of flood and sediment-discharge sources; and (4) remedial measures. Multiple-use management requires analysis, protection, repair, utilization and maintenance of watershed areas for optimum control and conservation of water. Through research, education and extension, watershed unknowns may be recognized, defined and quantified. Problems include watershed differences, plant-soil complexes, water interception, cost benefits, erosion minimization, channel losses, chemical defoliation and physiological effect on water loss. These concepts are of particular importance in arid and semiarid areas. (Popkin-Arizona)
W71-00959

FOREST HYDROLOGY AND EXTREME RAINFALL FREQUENCY,
Missouri Univ., Columbia. School of Forestry.
For primary bibliographic entry see Field 02A.
W71-01099

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

STORM WATER POLLUTION FROM URBAN LAND ACTIVITY, DEVELOPMENT OF ANALYTICAL PROCEDURES FOR PREDICTING STORM WATER POLLUTION FROM URBAN AREAS BY USE OF SELECTIVELY DEFINED URBAN CHARACTERISTICS.
Avco Economic Systems Corp., Washington, D.C.

Available from NTIS as PB-195 281, $0.95 in microfiche. Also for sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402. Price $2.00 SOD I67.13/4: 11034FKL 07/70. Water Pollution Control Research Series, 11034FKL 7/70, July, 1970. 325 p, 89 tab, 66 fig, 29 ref, 14 append. FWQA Program No 11034 FKL, Contract No 14-12-187.

Descriptors: Storm runoff, Storm drains, Urbanization, *Land use, Oklahoma, Cities, *Analytical techniques, Drainage systems, Water pollution control, Pollution abatement.
Identifiers: Tulsa (Okla), *Storm water pollution, Urban runoff.

An investigation of the pollution concentrations and loads from storm water runoff in an urban area was conducted in Tulsa, Oklahoma. The scope of the project included: a field assessment of the storm water pollution by obtaining samples of the water resulting from precipitation and surface runoff from selected test areas within the metropolitan area; development of an analytical procedure for correlation of storm water pollution with selectively defined variables of land uses, environmental conditions, drainage characteristics, and precipitation; and development of a plan for implementing remedial measures necessary to abate or control sources of pollution in an urban area. Storm water runoff samples were collected from 15 'discrete' test areas in the Tulsa metropolitan area for laboratory analysis in terms of quality standards for BOD, COD, TOC, organic Kjeldahl nitrogen, soluble orthophosphate, chloride, pH, solids, total coliform, fecal coliform, and fecal streptococcus pollutants. Selected land use parameters, environmental conditions, drainage and precipitation data, along with storm water pollution factors, provided input data for functional relationships to enable assessment of pollution from storm water runoff. Recommendations were made for a plan of action for preventing and controlling storm water pollution from urban areas.
W71-00619

OIL TAGGING SYSTEM STUDY.
Melpar, Falls Church, Va. Environmental and Applied Sciences Center.

Available from NTIS as PB-195 283, $0.95 in microfiche. Also for sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402. Price $1.50 per copy. I67.13/4: 15080DJ5/70. Federal Water Pollution Control Research Series DAST-11, May, 1970. 115 p, 7 tab, 8 fig, 174 ref. FWPCA Project 15080 DJQ 05/70, Contract No 14-12-500.

Descriptors: Marking techniques, Tracing techniques, *Tagging, Oil wastes, Oil industry, Pollutant identification, Analytical techniques, Tracers, Chemical analysis, Chromatography, Waste identification, Water pollution control.
Identifiers: *Oil tagging, *Surveillance, Enforcement, *Oil pollution.

Several methods of identifying the source of oil pollution are critically examined. These methods are grouped into two categories: passive tagging and active tagging. Passive tagging assumes that oils are so chemically diverse that their contents constitute a stable chemical fingerprint that can be unequivocally disclosed in the laboratory. Active tagging requires that an inexpensive, coded material be added to oil; this material must be chemically and physically stable in both oil and oil slicks; it must also be readily identifiable by available analytical techniques; and it must have no adverse effect on the oil's subsequent use. Three methods of passive tagging (trace metals, sulfur-isotope ratios, and paper chromatography) and three methods of active tagging (halogenated polycyclic aromatics, organometallies, and coded microspheroids) have been examined. Passive tags cannot be recommended because the passive tags are quite likely to mingle, to evaporate, to be dissolved, or to be oxidized; even if these processes do not occur, they can create formidable forensic problems for the prosecution and telling counter-arguments for the defense. Since active tags are designed to be stable and identifiable, they are satisfactory for the job; and the three types of active tags reviewed show promise and merit. (See also W70-04655).
W71-00624

COMPILATION OF DATA FOR MICHIGAN LAKES,
Geological Survey, Lansing, Mich.
For primary bibliographic entry see Field 02H.
W71-00637

FERTILIZER USE AND WATER QUALITY,
Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
G. Stanford, C. B. England, and A. W. Taylor.
U. S. Department of Agriculture, ARS 41-168, Oct 1970. 19 p, 1 tab.

Descriptors: *Water quality, *Nitrates, *Phosphates, *Water pollution, *Nutrients, Agriculture, Agricultural chemicals, Farm management, Hydrologic cycle, Water balance, Soil water, Subsurface water.
Identifiers: Nitrogen cycle, Math models of water and nutrient balances, Soil and water conservation.

This publication evaluates the role of nitrogen and phosphorus fertilizers in water pollution and summarizes the research on the complex relations between nutrient inputs and outputs. Available data do not often permit making valid estimates of nutrient transfer from fertilizer to ground and surface waters. A reliable basis for evaluating the effects of fertilizers on water quality requires quantitative measurements of water inputs and behavior in agricultural watershed studies that encompass appropriate ranges in climatic and management conditions. Future opportunities for manipulating the nitrogen balance in agriculture depend on further improvements in the technology of fertilizer use based on research. Practical methods must be developed for assessing not only the current nitrogen-supplying capacities of soils but also the changes that result from fertilizer use. Such estimates, coupled with greater knowledge of nitrogen requirements of crops and of management practices needed for most efficient nitrogen use, can

provide the basis for realistically predicting fertilizer needs of specific crops and meeting these needs effectively under different soil and climatic environments. Precise control of fertilizer use depends on gaining a better understanding through research of the behavior of applied nitrogen and phosphorus in soils. For example, leaching and runoff of nitrogen cannot be evaluated without a detailed understanding of water balance and water movement in soils. Also, the chemical and biological processes of immobilization, mineralization, and dentrification require further intensive study. (England-USDA)
W71-00639

THE EVALUATION OF SPECIES COMPOSITION AS A QUALITATIVE FACTOR IN PRIMARY PRODUCTIVITY,
American Univ., Washington, D.C. Dept. of Biology.
For primary bibliographic entry see Field 05C.
W71-00647

SPECTRAL ANALYSIS OF WATER QUALITY FLUCTUATIONS IN STREAMS,
Hydraulic Research Institute, Brno (Czechoslovakia).
V. Novotny, and I. Schmidtova.
Vodni Hospodarstri, XIX, No 9, Series 9, 1969, p 247. 3 fig, 1 tab, 7 ref.

Descriptors: *Mathematical studies, *Water quality, Mathematical models, Slushes, Time series analysis, Automation, Monitoring, Water analysis, Water quality control.

The application of harmonic analysis methods is described for the analysis of water quality records. By investigating the spectral density of the records, the possibility is indicated of analyzing the effects of periodic phenomena on the pattern of water quality changes in various stations. A practical example using a computer program showed how to carry out the analysis of the spectral density of the data recorded. The results of the analysis then permitted the determination of the optimal time for single collection, the investigation of the effect of the simple periodic phenomena on the data, and the approximate determination of the error affecting the statistical evaluation of the water quality at the single station. (Novotny-Vanderbilt)
W71-00651

THE USE OF ISOTOPES IN MEASURING PRIMARY PRODUCTIVITY,
Maryland Univ., College Park. Dept. of Botany.
For primary bibliographic entry see Field 05C.
W71-00652

CHLOROPHYLL ANALYSIS AS A METHOD OF EVALUATING THE STANDING CROP PHYTOPLANKTON AND PRIMARY PRODUCTIVITY,
Maryland Univ., Solomons. Natural Resources Inst.
For primary bibliographic entry see Field 05C.
W71-00657

GAS CHROMATOGRAPHIC DETERMINATION OF TOXIC SUBSTANCES AND THEIR METABOLITES IN ORGANISM-CONTAINING LIQUIDS. II. PHENOL AND p-CRESOL IN URINE (IN GERMAN),
Institute of Labor Hygiene and Occupational Diseases, Prague, Czechoslovakia.
V. Sedivec, and J. Flek.
Collection of Czechoslovak Chemical Communications, Vol 35, No 1, p 242-250, 1970. 3 fig, 14 ref.

Descriptors: *Toxins, *Urine, Phenols, Analytical techniques, Gas chromatography.
Identifiers: p-Cresol, Phosphoric acid, Carbon disulfide, Dispersion coefficients.

The phenolic compounds of urine are liberated from the coagulated form by heating the sample with phosphoric acid. The sample is extracted with carbon disulfide containing p-nitrochlorobenzol as the internal standard. The extract is heated to 150C with 5% of 20 mole polyethyleneglycol and the contents of phenol and p-cresol are determined by a gas chromatograph. The uncertainly of p-cresol determination is largely excluded because the isomer m-cresol is seldom present in urine. For the optimum results, the hydrolysis of coagulated phenolic compounds should be investigated at different degrees of acidification with the aim of establishing the relation between the aqueous phase dispersion coefficients of phenols and p-cresols and the concentration of phosphoric acid. (Wilde-Wisconsin)
W71-00673

SUGGESTED CLASSIFICATION OF WATER QUALITY BASED ON BIOLOGICAL CHARACTERISTICS,
Wasserwirtschaftsdirektion Werra-Gera-Unstrut, Erfurt (East Germany).
Wolf Von Tumpling.
Proceedings of the Fourth International Conference on Water Pollution Research, held in Prague, 2-6 September 1968, Section I, Paper 16. 8 p, 2 fig, 3 tab, 27 ref.

Descriptors: *Classification, *Water quality, Biological properties, Bioindicators, Regression analysis, Statistical methods, Biochemical oxygen demand, Correlation analysis, Water pollution control, Dissolved oxygen, Oxygen.
Identifiers: Saprobity, *Water quality criteria, Mesosaprobic range, Saprobic index, Ammonium ion.

As a basis of water quality clssification of flowing waters, the author chose the biological state of waters. Four recommended water quality classifications based on organic pollution (biological state) and on oxygen budget are given. Class I includes waters of high purity which is suitable for all uses. Class II includes waters with a moderate pollution load and high self-purifying capacity. Class III waters are highly polluted and have an oxygen budget which is loaded to the limits of aerobic conditions. The author emphasizes the need to consider other water quality criteria such as toxicity and salinity. (Katz-Washington)
W71-00922

AN IMPROVED METHOD FOR PREPARATION OF FECES FOR BOMB CALORIMETRY,
School of Aerospace Medicine, Brooks AFB, Tex.
Hubert G. Lovelady, and Emmett J. Stork.
Clinical Chemistry, Vol 16, No 3, 1970, p 253-254. 1 tab, 2 ref.

Descriptors: *Laboratory tests, Energy, Odor, *Farm wastes, Drying.
Identifiers: *Bomb calorimetry, Lyophilize.

As a preliminary to bomb calorimetry, weighed, homogenized fecal slurries are prefrozen and lyophilized. Advantages of this method over the method of drying in a vacuum oven include: more moisture is removed from the sample initially, drying time is reduced from 48h to 16 h, grinding is eliminated and objectionable odors are eliminated during sample processing. (Christenbury-Iowa State)
W71-00929

A RAPID EXTRACTION AND QUANTIFICATION OF TOTAL LIPIDS AND LIPID FRACTIONS IN BLOOD AND FECES,
Pittsburgh Univ., Pa. Dept. of Pathology.
J. S. Amenta.
Clinical Chemistry, Vol 16, No 4, 1970, p 339-346. 8 fig, 19 ref, 1 tab.

Descriptors: *Lipids, *Laboratory tests, Chemical analysis, Farm wastes.
Identifiers: *Feces, Plasma, Lipid fractions, Clinical laboratory, Cholesterol.

An analytical system for plasma lipids suitable for use in the large and small clinical laboratory is presented. Lipids are extracted into a chloroform-methanol solvent and concentrated into a chloroform phase by a wash with an aqueous CaCl2 solution. This extract is used to estimate total lipids and (after separation by thin-layer chromatography) the major lipid factions. A single acid dichromate reagent is used for all quantification of fecal lipids. Lipids in other body fluids can be conveniently analyzed with this flexible method. (Christenbury-Iowa State)
W71-00937

5B. Sources of Pollution

LEACHING OF CROP RESIDUES AS A SOURCE OF NUTRIENTS IN SURFACE RUNOFF WATER,
Agricultural Research Service, Morris, Minn.; and Minnesota Univ., Morris.
D. R. Timmons, R. F. Holt, and J. J. Latterell.
Water Resources Research, Vol 6, No 5, p 1367-1375, October 1970. 9 p, 8 tab, 8 ref.

Descriptors: *Leaching, *Nutrients, *Runoff, *Water pollution sources, Path of pollutants, Plants, Nitrogen, Phosphorus, Soil-water-plant relationships, Water quality, Eutrophication, Cycling nutrients.
Identifiers: Crop residues, Stubble.

Nitrogen and phosphorus losses were determined in plant leachates from alfalfa, Kentucky bluegrass, barley straw stubble, and oats straw stubble. Plant samples harvested from the field were either leached immediately or were desiccated by drying or freezing before leaching. The extraction of soluble nitrogen and soluble phosphorus in leachates from alfalfa and bluegrass was greatly increased by drying or freezing. These same treatments, however, released only small amounts of soluble phosphorus from barley and oats straw. Estimated soluble nutrient losses indicate that leaching of alfalfa and bluegrass by surface runoff water could contribute substantial amounts of nitrogen and phosphorus to lakes and streams. (Knapp-USGS)
W71-00584

SOIL-WATER SAMPLING USING PAN AND DEEP PRESSURE-VACUUM LYSIMETERS,
Pennsylvania State Univ., University Park. Mineral Conservation Section; and Water and Air Resources Commission, Dover, Del.
For primary bibliographic entry see Field 02G.
W71-00598

BERT V CITY OF ALLIANCE (CITY'S LIABILITY FOR POLLUTION OF RIVER BY SEWAGE TREATMENT PLANT).
For primary bibliographic entry see Field 06E.
W71-00609

DYNAMIC MODEL STUDY OF LAKE ERIE, PART I. SIMILITUDE CRITERIA AND EXPERIMENTAL SET-UP,
State Univ. of New York, Buffalo. Faculty of Engineering and Applied Sciences.
For primary bibliographic entry see Field 02H.
W71-00621

DYNAMIC MODEL STUDY OF LAKE ERIE, PART II, ANALYTICAL AND EXPERIMENTAL RESULTS,
State Univ. of New York, Buffalo. Faculty of Engineering and Applied Sciences.
For primary bibliographic entry see Field 02H.
W71-00622

OIL TAGGING SYSTEM STUDY.
Melpar, Falls Church, Va. Environmental and Applied Sciences Center.
For primary bibliographic entry see Field 05A.
W71-00624

DOES ARTIFICIAL GROUNDWATER RECHARGE CONTAMINATE OUR GROUNDWATERS,
Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering; Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
Marvin J. Dvoracek, and Rolland Z. Wheaton.
Available from the NTIS as PB-195 304, $3.00 in paper copy, $0.95 in microfiche. Paper presented at the Agricultural Waste Management Conference, Cornell University, Rochester, New York, January 19-21, 1970. 19 p, 32 ref. OWRR Project No B-041-TEX (3).

Descriptors: *Artificial recharge, *Water pollution sources, *Water pollution control, Groundwater, Groundwater movement, Path of pollutants, Water resources development, Water quality.
Identifiers: Groundwater quality protection.

Artificial recharge practices produce the possibility that groundwaters may be polluted or contaminated by undesirable substances introduced with the recharge waters. Various methods of artificial recharge and the contamination potential of each method are discussed. (Knapp-USGS)
W71-00628

WATER QUALITY DEGRADATION BY SEPTIC TANK DRAINAGE,
Maine Univ., Orono. Water Resources Research Center.
Millard W. Hall.
Available from NTIS as PB-195 307, $3.00 in paper copy, $0.95 in microfiche. OWRR Project No A-014-ME (2).

Descriptors: *Eutrophication, *Water pollution sources, *Nutrients, *Septic tanks, *Maine, Soil disposal fields, Phosphates, Adsorption, Ion exchange, Clays, Soil chemistry, Soil chemical properties, Biodegradation, Path of pollutants.
Identifiers: Nutrient retention (Soils).

Phosphorus retention by Maine soils was studied in the Adams, Plaisted, and Paxton soil series. Jar tests were undertaken to determine the rate and extent of phosphorus fixation. Parameters investigated included pH, temperature, soil, particle size, initial soluble phosphorus concentration in the system, and time of exposure. Leaching studies were conducted to determine the effect of various ions on the leaching process, and freeze-thawing experiments were performed to investigate the travel of phosphorus under varying environmental conditions. Soil column studies were conducted, using both an aqueous solution of known phosphorus concentration, and a natural septic tank effluent so that the effects of the soil biota on the retention of phosphorus could be determined. All three soils exhibited a significant capacity for phosphorus retention, but this capacity could be exhausted. Therefore, extreme care should be used in locating septic tank-drainfield waste water disposal systems adjacent to lakes or other surface waters that may be subjected to cultural eutrophication. Moreover, freezing and thawing may allow phosphorus initially retained in the soil to be more easily leached into surface waters. (Knapp-USGS)
W71-00631

THE GAUZE PAD METHOD FOR THE ISOLATION OF VIRUSES FROM INLAND AND ESTUARINE WATERS,
Rhode Island Univ., Kingston. Water Resources Center.
Louise T. Miller, and Oscar C. Liu.
Available from NTIS as PB-195 310, $3.00 in paper copy, $0.95 in microfiche. Completion Report (1970). 12 p. OWRR Project A-025-RI (1).

Descriptors: *Virus elution, *Virus adsorption, *Gauze pad.

The ultimate objective of this study was to examine the viral flora of waters from estuaries, inland ponds and streams of Rhode Island. However, prior to carrying out field examination, it was necessary to evaluate under controlled laboratory conditions these methods currently available for sampling, concentration and isolation of viruses with a view to selecting the most effective method or designing a method which would simplify sampling and improve recovery. The methods evaluated included the gauze pad technique, adsorption and elution from chemical flocs, combined flocculation and centrifugation, sonnication, and finally adsorption and elution from magnetic iron ore. The gauze pad was found to be inefficient for recovering virus from fresh water but its efficiency was enhanced slightly by the presence of inorganic salts in water, e.g., sea water. Combined flocculation and centrifugation improved viral recovery, but shoewed selectivity in the viruses recovered. The best results were obtained by adsorbing virus onto magnetic iron oxide followed by elution with blood serum solutions.
W71-00634

CITY OF LAKELAND V DOUGLASS (MUNICIPALITY'S POLLUTION OF LAKE AS NUISANCE).
For primary bibliographic entry see Field 06E.
W71-00713

THE PAN-AM (OIL POLLUTION BY OIL TANKER IN COASTAL WATERS).
For primary bibliographic entry see Field 06E.
W71-00716

HEGGLUND V UNITED STATES (CRIMINAL PROSECUTION FOR DISCHARGE OF OIL INTO NAVIGABLE WATERS).
For primary bibliographic entry see Field 06E.
W71-00741

THE EFFECT OF SALINITY ON THE REMOVAL OF SOME ALIPHATIC KETONES,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 05C.
W71-00789

JET DIFFUSION IN STAGNANT STRATIFIED WATERS,
Royal Inst. of Tech., Stockholm (Sweden).
Bengt Gustafsson, and Ian Larsen.
Water Research, Vol 4, No 5, p 353-361, May 1970. 9 p, 4 fig, 6 ref.

Descriptors: *Diffusion, *Jets, *Density stratification, Mixing, Dispersion, Turbulence, Density, Convection, Velocity, Path of pollutants, Density currents, Stagnant water.
Identifiers: Jet diffusion.

The rising of a jet due to buoyancy is discussed with special reference to horizontally injected jets in stratified fluids. A method for calculation of the maximum elevation of the jet is presented. The method is further simplified in the case of linearly varying density. The maximum value of surface density or salinity for which the jet will not be able to rise to the surface may be calculated. (Knapp-USGS)
W71-00835

RADIOACTIVE WASTE DISCHARGES TO THE ENVIRONMENT FROM NUCLEAR POWER FACILITIES,
Bureau of Radiological Health, Rockville, Md.
Joe E. Logsdon, and Robert I. Chissler.
Available from NTIS as PB-190 717, $3.00 in paper copy; and $0.95 in microfiche. Bureau of Radiological Health, Division of Environmental Radiation Report BRH/DER 70-2, March 1970. 77 p, 4 fig, 10 tab, 33 ref, 9 append.

Descriptors: *Nuclear powerplants, *Nuclear wastes, *Radioactive wastes, *Water pollution sources, Surveys, Radioisotopes, Tritium, Nuclear energy, Nuclear reactors, Radioactive waste disposal.
Identifiers: Radioactive waste sources.

Data pertaining to discharges of radioactive liquid and gaseous wastes from nine selected operating nuclear power facilities are presented and discussed. Careful waste management practices, engineered safeguards, and proper operating procedures generally result in radioactivity levels in waste effluents of a few percent or less of the AEC's licensed discharge limits. Exceptions are mostly associated with either an unusually high percentage of leaky fuel elements or with liquid discharge limits which are artificially low as a result of not analyzing liquid wastes for radionuclide content. A number of comparisons were made of power produced versus liquid or gaseous waste discharges. The most predominant trends are that boiling water reactors discharge relatively large quantities of gaseous waste and pressurized water reactors discharge relatively high quantities of tritium in liquid wastes. No obvious trend is discernible concerning quantities of waste discharge as a function of power generation. (Knapp-USGS)
W71-00856

SOURCES OF PESTICIDES IN FLORIDA WATERS,
Geological Survey, Tallahassee, Fla.
Aaron L. Higer, and Milton C. Kolipinski.
Geological Survey Open-file Report 70005, January 1970. 20 p, 1 fig, 3 tab, 13 ref.

Descriptors: *Pesticides, *Water pollution sources, *Florida, Citrus fruits, Chlorinated hydrocarbon pesticides, Organophosphorus pesticides, Carbamate pesticides, Metal organic pesticides, Data collections, Sampling, Surface waters.
Identifiers: Pesticide use (Florida).

Information on use of pesticides was collected as part of studies of their occurrence in natural waters in Florida. The information is intended for use in designing programs to monitor and trace pesticides in the hydrobiologic system. Use of pesticides in Florida was found to be greatest in the areas of established and expanding agricultural activities, especially the central citrus belt and the north-central and southern truckfarming regions. Approximately 34.0 million pounds of chlorinated hydrocarbon, orgranophosphate, carbamate, and metallo-organic pesticides were used during 1966. Of this total 25.6 million pounds were applied for the control of pests on citrus, vegetables, and melons. Lesser amounts were used on other crops, on lawns, in homes, and for mosquito control. (Knapp-USGS)
W71-00885

THE DEVELOPMENT OF THEORETICAL EQUATIONS TO DESCRIBE THE FLOW OF A RADIOACTIVE ION IN GROUNDWATER, ANNUAL REPORT, DECEMBER 1, 1966 TO NOVEMBER 30, 1967,
Geological Survey, Denver, Colo.
David B. Grove.
Report available as SC-CR-68-3637 from NTIS, $3.00 in paper copy, $0.95 in microfiche. Sandia Laboratories, Report SC-CR-68-3637, October 1969. 58 p, 9 fig, 1 tab, 30 ref. Contract AL-66-848.

Descriptors: *Path of pollutants, *Tracers, *Ion transport, *Porous media, *Groundwater movement, Tracking techniques, Filtration, Ion exchange, Convection, Dispersion, Mathematical models, Hydraulic models, Radioactive wastes, Nuclear wastes, Radioisotopes.
Identifiers: Radioactive ion transport.

A one dimensional transport equation that includes convective, dispersion, and ion exchange terms was derived for the flow of trace concentrations of ions through porous media. Ion-exchange concepts ex-

amined included instantaneous equilibrium, the use of theoretical plates, and the assumption of a second-order kinetic-rate reaction. The theoretical plate and kinetic rate ion exchange concept compared well with laboratory column experiments. The instantaneous equilibrium model's ease of use is its most attractive feature. A general partial differential equation utilizing the kinetic concept to describe the ion-exchange reaction was formulated into a finite difference equation by means of the Taylor's series and solved by a digital computer. A decrease in fluid velocity or an increase in the kinetic rate constant increases the peak concentration in the ionic pulse. High fluid velocities or low rate constants result in early peaks in the effluent from a laboratory column. (Knapp-USGS)
W71-00889

ATMOSPHERIC AEROSOL: DOES A BACKGROUND LEVEL EXIST,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
For primary bibliographic entry see Field 02B.
W71-00910

PONDS STOP POLLUTION FROM FEEDLOTS,
Soil Conservation Service, Salina, Kans.
George R. Smith, and F. DeWitt Abbott.
Soil Conservation, Vol 34, No 4, Nov 1968, p 78-79. 2 fig.

Descriptors: *Farm wastes, *Water Quality Act, Ponds, Kansas, Water pollution, Dams, Runoff, Soil, Sprinkler irrigation.
Identifiers: *Feedlots, Soil Conservation Service, Detention ponds, Kansas State Department of Health, Solid waste, Liquid waste.

In compliance with the Federal Water Quality Act of 1965 and a 1967 Kansas State law a northwest Kansas feedlot is retaining and disposing of animal wastes in a non-pollutional manner. The 14,000 head beef feedlots is located at the headwaters of a subdrainage area of Hackberry Creek. The feedlot, covering 100 acres, drains into two intermittent natural draws. Each draw has a pair of detention ponds. One collects solid wastes, and below this a second pond holds drainage from the first pond. Pipes with slide gates provide controlled drainage of liquids from the solid-waste ponds into the liquid waste ponds. The dams were built to state health department standards to contain 3 inches of runoff from the feedlot. The excess water from the lower ponds will be used for irrigation. The ponds are flat bottomed to facilitate removal of solid wastes. (White-Iowa State)
W71-00925

THE POTENTIAL DIGESTIBILITY OF CELLULOSE IN FORAGE AND FAECES,
University of New England, Armidale (Australia). Dept. of Agronomy.
R. J. Wilkins.
Journal of Agricultural Science, Vol 73, No 1, 1969, p 57-64. 1 fig, 6 tab, 35 ref.

Descriptors: *Farm wastes, *Cellulose, *Digestion, *Incubation, Grasses, Forages, Sheep, Nitrogen, Carbohydrates, Organic matter, Analytical techniques.
Identifiers: *Potential digestibility, *Digestibility coefficients, *Cellulose digestibility, Duration of digestion, Rumen, Ryegrass, Cooksfoot, Callide Rhodes grass, Samford Rhodes grass, Lignified and cutinized tissue.

The potential digestibility of cellulose is defined as the maximum digestibility obtainable when the conditions and duration of digestion are not limiting factors. Techniques for measuring potential cellulose digestibility were examined and the relationship between potential digestibility and in vivo cellulose digestibility was explored for a range of grasses. Cellulose digestibility was found to reach a maximum value after 5 days incubation in vitro. No further cellulose was digested when the residues from an initial incubation for 6 days were incubated with a second rumen liquor inoculum. The values measured after a single incubation of 6 days duration were similar to cellulose digestibility coefficients measured by the suspension of ground forage samples in nylon bags in the rumen for 6 days. Plant factors appear to limit further digestion and the residue from prolonged digestion in vitro consisted only of lignified and cutinized tissue. Potential cellulose digestibility measured by either of the above techniques was higher than cellulose digestibility in vivo. The difference varied between forages and when the difference was large, the digestibility of cellulose in faeces was high. It is suggested that measurements of the potential digestibility of cellulose in feed and faeces may be of use in estimating the digestibility of grazed herbage. (White-Iowa State)
W71-00926

SALMONELLA Spp. AND SEROTYPES OF ESCHERICHIA COLI ISOLATED FROM THE LESSER MEALWORM COLLECTED IN POULTRY BROODER HOUSES,
Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries and Wildlife.
Philip K. Harein, Ernesto De LasCasa, B. S. Pomeroy, and Mabel D. York.
Journal of Economic Entomology, Vol 63, No 1, February 1970, p 80-82. 3 tab, 20 ref.

Descriptors: *Farm wastes, *Poultry, *Salmonella, *E. coli, Cultures.
Identifiers: *Isolated, *Brooder houses, Litter, Mealworms, Pathogens.

Adult Alphitobius diaperinus (Panzer) were collected from the litter of poultry brooder houses in 1967 and 1968. One thousand of the lesser mealworms were individually surface disinfected, mascerated, and cultured in thioglycolate enrichment broth at 37 degrees C and streaked on cosin methylene blue agar or brilliant green agar plates for detection of Escherichia coli (Migula) Castelani and Chalmers and Salmonella spp., respectively. Five species of Salmonella found within the lesser mealworms were identified as S. heidelberg Kauffman, S. worthington Edwards and Bruner, S. saint paul Kauffman, S. typhimurium var copenhagen Kauffman, and S. chester Kauffman and Tesdal. Forty-eight serotypes of E. coli were recovered from within 251 lesser mealworms. Twenty-six of these serotypes are known pathogens for man or animals. (Miner-Iowa State)
W71-00928

INTERNATIONAL SHOE CO V GIBBS (POLLUTION OF STREAM BY MANUFACTURE).
For primary bibliographic entry see Field 06E.
W71-01025

PERRY V SIMPKINS (POLLUTION OF FARM AND STREAM BY FLUORSPAR MINE).
For primary bibliographic entry see Field 06E.
W71-01026

GAUVREAU V GULF REFINING CO (LIABILITY FOR POLLUTION OF WATER BY LEAKING GASOLINE TANK).
For primary bibliographic entry see Field 06E.
W71-01034

ROOT REFINERIES, INC V ROBERTSON (POLLUTION OF FARM STREAM BY OIL REFINERY).
For primary bibliographic entry see Field 06E.
W71-01035

BLANKENSHIP V KANSAS EXPLORATIONS, INC (DAMAGES FOR POLLUTION OF MILLPOND BY MINE SLUDGE).
For primary bibliographic entry see Field 06E.
W71-01036

NORTON COAL MINING CO V WILKIE (POLLUTION OF FARM BY COAL WASHERY).
For primary bibliographic entry see Field 06E.
W71-01038

ROSE V SOCONY-VACCUUM CORP (POLLUTION OF STREAMS BY SUBSTANCES IN GROUNDWATER).
For primary bibliographic entry see Field 06E.
W71-01043

BARRINGTON HILLS COUNTRY CLUB V VILLAGE OF BARRINGTON (DISCHARGE OF SEWAGE INTO RIPARIAN WATERS).
For primary bibliographic entry see Field 06E.
W71-01044

CITY OF CAPE GIRADEAU V HUNZE (MEASURE OF DAMAGES FOR STREAM POLLUTION CAUSED BY CITY SEWAGE DISTRICT).
For primary bibliographic entry see Field 06E.
W71-01047

5C. Effects of Pollution

A NOTE ON BACTERIAL GROWTH AROUND A RECHARGE WELL AT BAY PARK, LONG ISLAND, NEW YORK,
Geological Survey, Mineola, N.Y.
John Vecchioli.
Water Resources Research, Vol 6, No 5, p 1415-1419, October 1970. 5 p, 3 tab, 6 ref.

Descriptors: *Injection wells, *Reclaimed water, *Bacteria, Water reuse, Artificial recharge, New York, Water quality, Tertiary treatment, Aquatic microorganisms, Aquatic microbiology, Aquifers, Water pollution effects.
Identifiers: Bay Park (NY), Long Island (NY).

Highly treated sewage plant effluent is injected into a deep sand aquifer at Bay Park, Long Island, New York. High bacterial counts are observed in water pumped initially from the injection well after recharge termination, even though the injected water generally meets potable standards. Moreover, the number of bacteria recovered during pumping is much larger than the number injected. This suggests a growth of bacteria in the aquifer around the injection well, possibly in part on a filter mat of organic material formed at or near the aquifer-gravel pack interface during injection. Continued pumping results in lower counts until virtually bacteria-free water is produced. However, whenever pumping is stopped and restarted, the initial slug of water pumped shows higher counts than before shutdown. Apparently the surging action of the water dislodges bacteria that otherwise would not enter the well. (Knapp-USGS)
W71-00579

STREAM POLLUTION IN THE 'NEW LEAD BELT' OF S.E. MISSOURI,
Missouri Water Resources Research Center, Columbia.
Bobby G. Wixson, and Hong-Wen Chen.
Available from NTIS as PB-195 285, $3.00 in paper copy, $0.95 in microfiche. Missouri Water Resources Research Center, Completion Report, August 1970. 17 p, 1 tab, 5 fig, 11 ref. OWRR- A-021-MO (1).

Descriptors: *Mining, *Lead, *Zinc, Water quality, Fluorides, Missouri, Water pollution effects.
Identifiers: Milling Reagents.

This project studied the effects of lead-zinc mining and milling pollution in the Viburnum Trend or 'New Lead Belt' of S.E. Missouri. Results obtained from the project included the following: Stream pollution below the mine discharge was mainly due to the growth of large algal mats of Oscillatoria and bacteria which appear to result from the discharge of sodium isoprophyl xanthate in the milling waste

water. Limits were established for the precipitation of lead, zinc, and copper in relationship to pH and other water quality parameters. The amount of fluorides in the streams may be used as an indicator of mining water discharges. New techniques may be used to evaluate organic milling reagents in the water and in the biota. Diatoms may be used as biological indicators of mine waste water effects.
W71-00627

WATER QUALITY DEGRADATION BY SEPTIC TANK DRAINAGE,
Maine Univ., Orono. Water Resources Research Center.
For primary bibliographic entry see Field 05B.
W71-00631

POTENTIAL THERMAL EFFECTS OF AN EXPANDING POWER INDUSTRY: UPPER MISSISSIPPI RIVER BASIN,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
D. E. Peterson, and R. T. Jaske.
AEC Research and Development Report, BNWL-1405, UC-70 June, 1970, p 94. 22 fig, 21 tab, 17 ref. US AEC Contract AT (45-1)-1830.

Descriptors: *Thermal pollution, *Temperature, Computer models, Flow, Thermal power plants, Ice, Navigation, Precipitation (Atmospheric), Run off, Heat budget, Computer programs, Minnesota, Illinois, *Simulation, *Model studies.
Identifiers: Upper Mississippi, River Basin, Cooling capacity, Power growth, Heat sink, Thermal load.

Direct cooling capacities of the main stem Mississippi River and eight major tributaries between Royalton, Minnesota and Alton, Illinois for average and low flow conditions were simulated within a temperature constraint of 5F above natural background. Total assimilative and dissipative capacity of the upper Mississippi Basin ranged from a high of 130 GWT to a low of 46 GW sub T. Analyses of projected power growth patterns indicate that the main stem has adequate cooling capacity to accommodate forecasted loads through the year 1990, except in the St. Paul-Minneapolis area. Partial recirculatory cooling facilities appear to be a possible solution to tributary basin cooling water requirements beyond the year 1980. (Upadhyaya-Vanderbilt)
W71-00644

SIMULATION OF THE EFFECTS OF HANFORD AT THE WASHINGTON-OREGON BORDER,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
R. T. Jaske, and D. G. Daniels.
U. S. AEC Contract AT (45-1)-1830. AEC Research and Development, BNWL-1344, VC-70, July, 1970, p 33. 16 fig, 2 tab, 4 ref.

Descriptors: *Thermal pollution, Temperature, *Mixing, Isotherms, *Stratification, Heat transfer, Reservoirs, Depth, Oregon, Washington, Model studies, *Simulation.
Identifiers: Hanford plant, COLHEAT simulation model, Thermal discharge, Power level, Temperature transect, Columbia River.

A series of transects taken in the summer and fall of 1969 at the Oregon and Washington border are used as the basis for checking the accuracy of the COLHEAT simulation model and the extent of stratification and mixing which occurs in the reservoir under conditions where solar thermal input is at a maximum. The model is then used to estimate the extent to which heat additions at the Hanford Plant (Columbia River Mile 382) persist to the Washington-Oregon border (River Mile 308) under a range of statistically determined extreme and normal conditions expected after completion of the Columbia Treaty dams in 1975. The results show that 65% or more of the incremental addition to the temperature of the Columbia River between Priest Rapids dam and Richland is dissipated in the reach under study. The remaining 35% is only weakly related to the weather in terms of yearly variations. The study suggests the practicability of using computer simulation as the basis for management of stream standards using in situ stream conditions as the basis of the judgment. (Upadhyaya-Vanderbilt)
W71-00645

THE EVALUATION OF SPECIES COMPOSITION AS A QUALITATIVE FACTOR IN PRIMARY PRODUCTIVITY,
American Univ., Washington, D.C. Dept. of Biology.
Richard R. Anderson.
Chesapeake Science, Vol 10, No 3 and 4, Sept-Dec, 1969, p 307-312. 28 ref.

Descriptors: *Phytoplankton, *Chlorophyll, *Benthos, Marshes, *Periphyton, Sampling, Aquatic environment.
Identifiers: Infrared photography, Thermal addition, Cell count.

The older and largely obsolete method for sampling phytoplankton communities is the fine silk net. Problems encountered include variations in pore size due to manufacture degree of wetting, age and strain. Pumping known volume of water through suitable filters, which then can be washed to retrieve the phytoplankton, appears to solve sampling problems. Counting trays such as the Russel model or hemocytometer slide are used for determination of species and cell number with a microscope. Benthic and Periphylic plants make ideal indicators of species and biomass change within an area where environmental alteration is occurring, since the adults do not readily move to new areas. Investigations using SCUBA and underwater photography are only useful in water with relatively little sediment load. Bottom grabs or dredges appear to best facilitate benthos sampling. Anderson has found color in delineating major marsh plant communities. (Upadhyaya-Vanderbilt)
W71-00647

MEASURING DISSOLVED OXYGEN AS AN INDICATOR OF PRIMARY PRODUCTIVITY,
Rutgers-The State Univ., New Brunswick, N.J.
Kent Mountford.
Chesapeake Science, Vol 10, No 3 and 4, Sept-Dec, 1969, p 327-330. 14 ref.

Descriptors: *Dissolved oxygen, *Primary productivity, Polarographic analysis, Calibrations, Aquatic environment.
Identifiers: Light-dark bottle, Winkler method, Carbon fixation, Microgasometry, Manometry.

The estimation of primary productivity using dissolved oxygen data is predicted upon the relationship between oxygen evolution and carbon fixation. In the current Barnegat Ray investigation, the change in mg O2/1 was multiplied by 0.375 to obtain a first order approximation of fixation of carbon into organic compounds. Gaarder and Gran first proposed the technique using light and dark bottles with the Winkler titration to measure the production and consumption of oxygen. The contribution of oxygen dissolved in the reagents, volatilization and air-oxidation of iodine in the transfer at aliquots for titration, and direct errors in burette reading and detection of the end point are the sources of error in the Winkler method. Polarographic techniques and their advantages are also described. Scholander described an elegant technique which requires only about 1 ml of sample for the determination of dissolved oxygen, even in polluted waters, with an accuracy of 2 percent. Manometry does not require the measurement of oxygen to estimate carbon fixation and, indeed can directly measure changes in CO2. (Upadhyaya-Vanderbilt)
W71-00649

THE USE OF ISOTOPES IN MEASURING PRIMARY PRODUCTIVITY,
Maryland Univ., College Park. Dept. of Botany.
Raymond A. Galloway.
Chesapeake Science, Vol 10, No 3 and 4, September - December 1969, p 331-335. 55 ref.

Descriptors: *Radioisotopes, *Primary productivity, Radioactivity, Incubation, Sampling, Time, *Biomass, *Aquatic microorganisms.
Identifiers: 14C, Photosynthate, Dark fixation, Activity.

Primary production is most often based on either the rate of carbon assimilation or the rate of oxygen production. One of the most sensitive measures of primary production is by 14C-technique originally developed by Steemann and Nielsen (J. Cons. Perm. Int. Explor. Mer. 18: 117-140, 1952). Measured water samples are placed in bottles together with known amounts of 14C, usually in the form of bicarbonate. Bottles were exposed to approximately 2000 foot-candles of illumination for 3 to 6 hours in a bath. After incubation, cells were filtered and washed in sea water. The filters were dried for 12 hours and exposed to fuming HCL to remove all absorbed organic carbon before making radioactive counts. Time and sampling are the problem in this procedure. Another problem inherent in the approach is that of dark CO2 fixation. Loss of 14C can also occur from normally functioning, living cells. Contains 55 references. (Upadhyaya-Vanderbilt)
W71-00652

EFFECT OF TEMPERATURE ON OXYGEN TRANSFER IN WATER,
Windsor Univ. (Ontario); Tennessee Valley Authority, Chattanooga; and Wisconsin Univ., Madison.
Jatinder K. Bewtra, William R. Nicholas, and Lawrence B. Polkowski.
Water Research, 1970. Vol 4, No 1, p 115-123, January 1970. 5 fig, 1 tab, 11 ref.

Descriptors: *Temperature, *Aeration, Reaeration, Regression analysis.
Identifiers: Saran tubes, Spargers, Oxygen transfer rates, Air flow rates.

The effect of temperature on oxygen transfer by diffused-air aeration is presented. The study was made in a full scale aeration tank using both saran tubes and spargers as the diffusion media at aeration rates from 7 to 32 ft 3 per min. per foot of tank length. The oxygen transfer was measured in water through a temperature range of 10-30C in 2.5C increments. In an aeration tank with bubble aeration at a given rate, the percent ratios of the rates of oxygen absorbed to the oxygen supplied in tap water are the same, at temperatures between 10C and 30C and zero dissolved oxygen concentration. The value of K sub L A changes with temperature, T, according to the equation (K sub L A) sub T equal (K sub L A)20C (T-20), where A is the interfacial contact area between air bubbles and liquid, and K sub L is the over all transfer coefficient. The value of C for the aeration devices, saran tubes, and spargers, was found to be 1.0192. Airflow rates within the range of 7-32 cu ft per min per foot tank length have no significant effect on this constant. (Upadhyaya-Vanderbilt)
W71-00654

CHLOROPHYLL ANALYSIS AS A METHOD OF EVALUATING THE STANDING CROP PHYTOPLANKTON AND PRIMARY PRODUCTIVITY,
Maryland Univ., Solomons. Natural Resources Inst.
David A. Flemer.
Chesapeake Science, Vol 10, No 3 and 4, September-December 1969. p 301-306. 51 ref.

Descriptors: *Chlorophyll, *Primary productivity, Standing crop, *Phytoplankton, Aquatic environment.
Identifiers: Assimilation number, Absorption coefficient.

The accuracy of chlorophyll a determination is subject to important errors resulting from chlorophyll degradation products, as are determinations for other chlorophylls which have absorption maxima near that of chlorophyll a. This problem is especially likely to occur in shallow estuaries where bottom deposits are resuspended by wind and tidal currents or in samples collected from fixed substrates, e.g., glass slides. Choice of specific absorption coefficient, and the nature of pure pigments used for calibration can affect the spectrophotometric estimation of chlorophyll. (Upadhyaya-Vanderbilt)
W71-00657

INFORMATION PROCESSING IN WATER RESOURCES RESEARCH,
O'Brien and Gere, Syracuse, N.Y.
For primary bibliographic entry see Field 07B.
W71-00662

SEASONAL VARIATION IN SELECTED NUTRIENTS OF A RIVER SYSTEM,
Guelph Univ. (Ontario). Dept. of Zoology.
H. R. MacCrimmon, and J. R. M. Kelso.
Journal Fisheries Research Board of Canada, Vol 27, No 5, p 837-846, 1970. 2 fig, 2 tab, 15 ref.

Descriptors: *Fluctuation, *Nutrients, *River systems, *Water pollution effects, Sampling, Water chemistry, Municipal wastes, Agricultural watersheds, Dissolved oxygen, Carbon dioxide, Hydrogen ion concentration, Alkalinity, Hardness (Water), Ammonia, Nitrates, Silicates, Chlorides, Nitrites, Phosphates, Iron, Sulfates, Industrial wastes, Great Lakes region, Swamps, Temperature, Water pollution sources, Cycles.
Identifiers: Grand River (Ontario), Seasonal variations.

Grand River, Ontario, headwater nutrient levels and associated water chemistry were radically altered by the influence of a small city. Extreme levels of nitrogen, spectacular changes in phosphate, and the chronic summer depletion of dissolved oxygen appeared below Guelph. Recovery processes occurred downriver in a primarily agricultural watershed. Dissolved oxygen levels, carbon dioxide, pH, alkalinity, hardness, ammonia, nitrate, and silica followed similar seasonal patterns at all test locations. High and widely fluctuating levels of chloride, ammonia, nitrate-nitrogen, nitrite, and orthophosphate were evidence of gross enrichment; nitrate-nitrogen, orthophosphate, iron, and sulfate levels varied irregularly during the 13-month observation period (August 1967-September 1968). Variations in nutrient levels and associated chemical conditions show the limitation of spot sampling in assessment of water quality, particularly if natural nutrient levels and the pattern and range of these fluctuations are unknown; it is only through publication of methodology and long-term investigations, that the limited knowledge of the complex chemistry of river water can be expanded so that increasing eutrophication and water quality control may be better understood and dealt with effectively. (Jones-Wisconsin)
W71-00664

BOTTOM FAUNA AND EUTROPHICATION,
Copenhagen Univ., Hillerod (Denmark). Freshwater-biological Lab.
Petur M. Jonasson.
Eutrophication: Causes, consequences, correctives, p 274-305. Printing and Publishing Office, National Academy of Sciences, Washington, DC, 1969. 10 fig, 3 tab, 47 ref.

Descriptors: *Benthic fauna, *Eutrophication, *Nutrients, Lakes, Ecology, Primary productivity, Algae, Plankton, Submerged plants, Physicochemical properties, Phytoplankton, Distribution, Depth, Oxygen, Alkalinity, Hydrogen ion concentration, Standing crop, Light, Biomass, Respiration, Life cycles, Oligochaetes, Mollusks, Stratification, Diatoms, Chlorophyta, Cyanophyta, Daphnia, Snails.
Identifiers: Lake Ersom (Denmark).

Bottom fauna fits into an ecological pattern set by primary production of algae, submerged macrophytes, and physical and chemical factors. The physicochemical factors affect size and seasonal trend of primary production. In turn, primary production determines range of various physical and chemical factors at the bottom. Phytoplankton production, vertical distribution and abundance of macrophytes are important determinants of oxygen regime, alkalinity, pH, and other factors especially important in relation to vertical and temporal variation. Bottom fauna is correspondingly affected in quality, quantity, and depth distribution. Above the thermocline is a rich fauna with high oxygen demands; below the thermocline are a few specialists tolerating low oxygen tension. These qualitative contrasts are paralleled by quantitative contrasts. Increasing nutrients to epilimnion results in increased standing crop and phytoplankton production. Macrophytes climb to compensate for decreased illumination. Lake changes into one devoid of submerged vegetation, dominated by Nymphoids showing only the lower peak of animal biomass. Increasing nutrients to hypolimnion causes rapidly developing oxygen deficit, lowering respiratory activity, reducing growth periods, and other adverse effects on bottom fauna. During final stage of eutrophication, sessile mud-dwellers may drop to almost zero or become restricted to Oligochaetes. (Jones-Wisconsin)
W71-00665

PHYSIOLOGICAL-ECOLOGICAL STUDIES OF BENTHIC ALGAE IN LABORATORY STREAMS,
Oregon State Univ., Corvallis. Dept. of Botany.
For primary bibliographic entry see Field 07B.
W71-00668

INTERACTION OF PESTICIDES WITH NATURAL ORGANIC MATERIAL,
Geological Survey, Denver, Colo.
R. L. Wershaw, P. J. Burcar, and M. C. Goldberg.
Environmental Science and Technology, Vol 3, No 3, p 271-273, 1969. 3 fig, 1 tab, 9 ref.

Descriptors: *Pesticides, *DDT, 2-4-5-T, Adsorption, Solubility, Organic matter, Water pollution, Humic acids, Surface tension.
Identifiers: Organic polyelectrolytes, Langmuir adsorption equation, Lauryl sulphate solution.

By lowering the surface tension of water, organic polyelectrolytes, such as humic acid, facilitate solubility of otherwise insoluble pesticides. On the other hand, the high adsorption capacity of humate fraction precludes an uptake of eradicants by the roots. These relationships were demonstrated by the use of sodium humate and humic acid to solubilize the DDT and adsorb the 2,4,5-T from solution. (Wilde-Wisconsin)
W71-00674

STREAM OF ENERGY IN THE ECOSYSTEM OF AN EUTROPHIC LAKE (IN RUSSIAN),
Akademiya Nauk SSSR. Zoologicheskii Institut.
For primary bibliographic entry see Field 02H.
W71-00678

TROPHIC NATURE OF SELECTED WISCONSIN LAKES,
Wisconsin Dept. of Natural Resources, Madison. Div. of Environmental Protection.
For primary bibliographic entry see Field 02H.
W71-00682

A PREDATOR-PREY RELATIONSHIP. SEA STARS-BIVALVES. THE CHEMICAL BASIS OF THE RESPONSE OF ASTERIAS VULGARIS TO CRASSOSTREA VIRGINICA. A BIOASSAY, ITS APPLICATIONS AND THE PARTIAL PURIFICATION OF AN ACTIVE EXTRACT,
Woods Hole Oceanographic Institution, Mass.
K. J. Whittle, and M. Blumer.
Available from NTIS as AD-708 682, $3.00 in paper copy, $0.95 in microfiche. Technical Report, May 1970. 77 p. Reference No 70-20.
Identifiers: *Echinodermata, Responses, *Pelecypoda, Secretion, *Secretion, Chemical analysis, Chemicals, Stimulation, Purification, Ecology, Water pollution, Oceans, Sensory perception, Thresholds (Physiology), Sensitivity, Marine biology, Biological assay, *Asterias vulgaris, *Crassostrea virginica, *Chemotaxis, *Predation.

The chemical basis of the predator/prey relationship, sea stars/bivalves, was examined. Under controlled conditions in a flow-tank, Asterias vulgaris senses intact oysters (Crassostrea virginica) upstream at distances of at least 120 cm. and shows a positive chemotaxis. It responds similarly to aqueous extracts of oyster tissue at concentrations as low as a few parts per billion. The threshold sensitivity of Asterias vulgaris and Asterias forbesi for an oyster extract was compared. It was measured also for A. vulgaris relative to other bivalves. Contamination of the testing tank with particulate suspensions and oil dispersions at concentrations of less than 10 10 mg/liter is sufficient to decrease the response to oyster extract and to lower the threshold sensitivity of the sea stars. A reliable, repeatable method was developed for the partial purification of the oyster extract. Infrared spectroscopy indicates that the major functional groups are -OH, -NH and -COOH. It is probable that the activity is centered in a number of polar, low molecular weight compounds. They are heat stable at 100C stable to acid, and not hydrolyzable.
W71-00787

THE EFFECT OF SALINITY ON THE REMOVAL OF SOME ALIPHATIC KETONES,
Texas A and M Univ., College Station.
Tariq A. Mahmoud, and William B. Davis.
Available from NTIS as PB-193 401, $3.00 in paper copy, $0.95 in microfiche. July 1970, 106 p. Sea Grant Publication No. TAMU-SG-70-216.
Identifiers: *Water pollution, *Organic compounds, *Microorganisms, Salinity, Ketones, Aliphatic compounds, Wastes (Industrial), Control, Metabolism, Estuaries, Physiology, Bacteria, Pseudomonas, Fungi, Theses, Cephalosporium.

Basic and definitive information pertaining to the effect of salinity on the microbial behavior is essential to determine the fate of organic pollutants discharged into the estuaries, and to determine design and operation parameters of plants subjected to salinity variation. Twenty-five batch tests were run to determine the long and short term effect of salinity variation on the microbial behavior of cultures established in various salinity levels and tested under different salinity conditions. Aliphatic ketones namely, acetone, 2-butanone and 2-pentanone were used as a carbon source in this study because of their appearance in many industrial wastes. Organisms acclimated to ketones in media varying from fresh water to sea water salinity were identified to genera and in two instances to species. The following conclusions were observed: (1) Two predominant genera, Cephalosporium and Psendomonas, were common to all salinity levels. (2) Minor species were displaced with the progressive increase in salinity level. These two observations lend credence that a reduced removal rate at a higher salinity level was due not to the change in population structure but to the physiological effects of the increase salinity on the uptake and metabolism of the substrate by organisms.
W71-00789

PRIMARY PRODUCTIVITY, CHEMO-ORGANOTHROPHY, AND NUTRITIONAL INTERACTIONS OF EPIPHYTIC ALGAE AND BACTERIA ON MACROPHYTES IN THE LITTORAL OF A LAKE,
Michigan State Univ., East Lansing. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 02H.
W71-00832

STUDIES ON WATER QUALITY AND THE ABSENCE OF FISH FROM SOME POLLUTED ENGLISH RIVERS,
Water Pollution Research Lab., Stevenage (England).
V. M. Brown, D. G. Shurben, and D. Shaw.
Water Research, Vol 4, No 5, p 363-381, May 1970. 19 p, 12 fig, 8 tab, 24 ref.

Descriptors: *Water pollution effects, *Toxicity, *Fishkill, *Poisons, Estuaries, Fish, Morbidity, Mortality, Industrial wastes, Water pollution, Rivers, Water quality, Ammonia, Copper, Phenols.
Identifiers: Cyanide, Zinc, England.

Field studies were made in England to determine the acute, lethal toxicity of some polluted river waters and an estuary water to rainbow trout, brown trout, roach, and dace. The 48 hr median lethal concentrations, for rainbow trout, of dilutions of the polluted fresh waters were found to be about 65 per cent of those predicted from the chemical qualities of the waters. Prediction seriously underestimated the toxicity of the saline waters. (Knapp-USGS)
W71-00834

EFFECTS OF COPPER ON GAMMARUS PSEUDOLIMNAEUS, PHYSA INTEGRA, AND CAMPELOMA DECISUM IN SOFT WATER,
National Water Quality Lab., Duluth, Minn.
John W. Arthur, and Edward N. Leonard.
Journal of the Fisheries Research Board, Canada, Vol 27, No 7, p 1277-1283, 1970. 5 tab, 12 ref. FWQA Program 18050---9/70.

Descriptors: *Heavy metals, *Copper sulfate, *Amphipoda, *Snails, *Bioassay, Life history studies, Toxicity.
Identifiers: *Chronic copper toxicity, *Acute copper toxicity, Safe toxicity levels, Continuous flow bioassays.

Three invertebrate species were subjected to acute (96-hr) followed by long-term (6-week) copper exposures under continuous flow bioassay conditions. Survival, growth, reproduction, and feeding were the responses used for measuring toxicant effects. The average 96 hr TLm values for Campeloma decisum, Physa integra, and Gammarus pseudolimnaeus were 1.7, 0.039, and 0.020 mg/liter total copper, respectively. The total copper concentration having no effect after 6 weeks' exposure for all three species, was between 8.0 and 14.8 micrograms/liter. The newly hatched amphipods obtained from the second six week study were exposed to copper for 9 additional weeks, and grew to the adult stage only in copper concentrations less than or equal to 4.6 micrograms/liter. After 5 weeks' exposure to a water system, survival of newly hatched Gammarus was markedly reduced between copper concentrations of 12.9 and 6.2 micrograms/liter.
W71-00907

CHRONIC EFFECTS OF LINEAR ALKYLATE SULFONATE DETERGENT ON GAMMARUS PSEUDOLIMNAEUS, CAMPELOMA DECISUM, AND PHYSA INTEGRA,
National Water Quality Lab., Duluth, Minn.
John W. Arthur.
Water Research, Vol 4, No 4, p 251-257, 1970. 4 tab, 17 ref. FWQA Program 18050---10/70.

Descriptors: *Detergents, *Amphipoda, *Snails, *Bioassay, Toxicity, Life history studies.
Identifiers: *Chronic detergent toxicity, *Acute detergent toxicity, Safe toxicity levels, Continuous flow bioassays.

Three invertebrate species were submitted to acute (96 hr) followed by chronic (6 week) detergent exposures. The average 96 hr TLm values for Campeloma decisum, Physa integra, and Gammarus pseudolimnaeus were 27, 9, and 7 mg/l linear alkylate sulfonate (LAS), respectively. Newly hatched amphipods that were covered after termination of the second 6 week study were further exposed to the detergent for 15 additional weeks, thus enabling more than one generation cycle to be tested under toxicant stress. Survival, growth, reproduction, feeding, and mobility were the responses used for determining the chronic toxicant effects. Under the test conditions described, the maximum acceptable LAS concentrations for Gammarus pseudolimnaeus and Campeloma decisum were between 0.2-0.4 and 0.4-1.0 mg/l, respectively. Responses by Physa integra were not significantly altered under the chronic test concentrations.
W71-00908

EFFECTS OF ABATEMENT OF DOMESTIC SEWAGE POLLUTION ON THE BENTHOS, VOLUMES OF ZOOPLANKTON, AND THE FOULING ORGANISMS OF BISCAYNE BAY, FLORIDA,
Miami Univ., Fla. Inst. of Marine and Atmospheric Sciences.
Kneeland J. McNulty.
Studies in Tropical Oceanography No 9, University of Miami Press, Coral Gables, Florida, March 1970. 107 p, 19 fig, 10 tab, 155 ref. FWQA Program 18050-03/70.

Descriptors: *Water pollution effects, Domestic wastes, *Pollution abatement, Water pollution control, Benthos, *Benthic fauna, *Benthic flora, Zooplankton, Florida, Comparative productivity, Aquatic environment, Aquatic populations, Dredging, *Bottom sediments, Phosphorus, *On-site investigations, On-site data collections, Amphipoda, Water quality.
Identifiers: Fouling organisms, *Biscayne Bay, Florida, Barnacles, *Bottom communities, Literature review.

Various elements of the biota of northern Biscayne Bay, Florida, were studied before and after abatement of pollution. The pollution consisted of 136 to 227 million liters per day of untreated domestic sewage. Four years after removal of the pollution certain changes had taken place. At distances of 100 to 740 meters seaward from outfalls, in water depths of one to three meters in hard bottom, populations of benthic macroinvertebrates had declined from abnormally large numbers of species and individuals to normal numbers of each, while soft-bottom populations had changed qualitatively but not quantitatively. Adjacent to outfalls, populations had increased in numbers of species and numbers of individuals in hard sandy bottoms only. Volumes of zooplankton had decreased to about one-half the pre-abatement values in poorly flushed waters; elsewhere, they remained about the same. Dissolved inorganic phosphate-phosphorus decreased similarly. Abundance of amphipod tubes had declined markedly, a change not shared by the quantities of other fouling organisms (including barnacles), which remained about the same. There was no evidence of improved commercial and sport fishing following abatement; this is interpreted to mean that long-lasting detrimental effects have resulted from pollution and dredging. (Katz-Washington)
W71-00919

INFLUENCE OF OXYGEN CONCENTRATION AND WATER MOVEMENT ON THE GROWTH OF STEELHEAD TROUT AND COHO SALMON EMBRYOS,
Oregon State Univ., Corvallis. Dept. of Fish and Game Management.
Dean L. Shumway, Charles E. Warren, and Peter Doudoroff.
Transactions of the American Fisheries Society, Vol 93, No 4, 1964, p 342-356. 10 fig, 3 tab, 3 ref.

Descriptors: *Water pollution effects, Oxygen requirements, *Dissolved oxygen, Water temperature, *Fish eggs, Fish management, Fish physiology, Growth rates, Environmental effects, *Embryonic growth stage, *Hatching, Laboratory tests, Salmonids, Mortality, Regression analysis, Viability.
Identifiers: *Coho salmon, *Steelhead trout, *Water movement, Water velocities, Hatching time.

Embryos of coho salmon and steelhead trout were reared from fertilization of the eggs to hatching, at about 10 degrees C, at different concentrations of dissolved oxygen ranging from about 2.5 to 11.5 mg/liter and at different water velocities ranging from about 3 to 750 cm/hour. Some of the embryos rested on porous plates, while others were buried in glass beads so as to simulate natural conditions more closely. Fry from embryos reared at low and intermediate oxygen concentrations hatched later and were smaller in size at hatching than fry from embryos reared at concentrations near the air-saturation level. At all oxygen concentrations tested, reduced water velocities resulted in reduced size of hatching fry. This effect of velocity was nearly as pronounced at high oxygen concentrations as at low concentrations. The effect of the difference of water velocity tested was less than the effect of the difference of oxygen concentrations tested. When some embryos were buried in glass beads while others were not, and the discharge rates of water through cylinders containing the embryos were the same, the fry that hatched in the cylinders containing beads were larger in size than those in cylinders without beads. This effect is ascribed to the increase of water velocities around the embryos buried in beads. It was usually most pronounced when a mixture of large and small beads was used. (Katz-Washington)
W71-00920

THE ACUTE LETHAL TOXICITY TO RAINBOW TROUT OF MIXTURES OF COPPER, PHENOL, ZINC AND NICKEL,
Water Pollution Research Lab., Stevenage (England).
V. M. Brown, and R. A. Dalton.
Journal of Fisheries Biology, Vol 2, p 211-216, 1970. 2 fig, 3 tab, 11 ref.

Descriptors: *Bioassay, Toxicity, *Copper, *Phenols, Heavy metals, Rainbow trout, Lethal limit, Water pollution effects, Copper sulfate, Estimating.
Identifiers: *Zinc, Nickel, Toxic mixtures, Fractional toxicities, *Predicted toxicity.

The acute lethal toxicities to rainbow trout, Salmo gairdneri Richardson, of mixtures of copper and phenol, of copper, zinc and phenol, and of copper zinc and nickel, over an exposure period of 48 h were determined. The 48 - h LC50 values were 1.17, 1.07, and 1.01 mg/l, respectively. The concentrations selected for testing were such that each poison theoretically contributed equally to the toxicity of the mixture. It was found that the toxicities of these mixtures could be adequately predicted by summation of the fractional toxicities of the particular poisons which were present. (Katz-Washington)
W71-00921

THYROXINE ANTAGONISM OF PENTACHLOROPHENOL POISONING IN CICHLID FISH,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
James N. Pasley, George G. Chadwick, and Hugo Krueger.
Proceedings of the Western Pharmacological Society II, p 129-132, 1968. 3 tab, 12 ref. USPHS Grants ITI GM 1192 and EF 105.

Descriptors: Phenols, Cichlids, *Fish physiology, Mode of action, Animal metabolism, *Biochemistry, *Growth rates, Lipids.
Identifiers: *Thyroxine, Antagonism, *Pentachlorophenol, Ash content, Protein content.

Control cichlids had higher wet weight, dry weight, lipid and water content than the cichlids exposed to thyroxine (T) alone or to sodium pentachlorophenol (NaPCP) alone. Protein and ash

content of control cichlids did not vary markedly from those exposed to thyroxine or to NaPCP. The combination of T.. NaPCP led to an increase in wet weight, dry weight, and lipid and protein fraction content above that of control cichlids. Thyroxine alone and NaPCP alone reduced growth, but when cichlids were exposed to a combination of both substances a somatotropic effect was exerted. The changes from controls in weights of water, fat, ash, and protein fraction were not proportional and thus exposure to Thyroxine, NaPCP, and T..NaPCP altered the composition of the cichlids. (Katz-Washington)
W71-00923

EFFECT OF DIETS CONTAINING DEHYDRATED POULTRY WASTE ON QUALITY CHANGES IN SHELL EGGS DURING STORAGE,
Michigan State Univ., East Lansing. Dept. of Poultry Science.
L. R. York, C. J. Flegal, H. C. Zindel, and T. H. Coleman.
Poultry Science, Vol 49, No 2, p 590-591, March 1970. 1 tab, 3 ref.

Descriptors: *Farm wastes, *Poultry, *Dehydration, *Diets, Eggs.
Identifiers: *Haugh unit, *Qaulity changes, Color and odor observations, Waste feeding, Manure utilization, Dried poultry wastes.

Eggs from 32 Leghorn-type hens on each of four diets were used. All the birds were 10 months of age and had been on the experimental diet for three months. The diets used were (1) control, (2) control with 10% DPW, (3) control with 20% DPW, and (4) control with 30% DPW. One-day-old eggs were stored at room environment to accelerate the changes that occur during storage. Room temperature varied from 22 degrees C to 25 degrees C and relative humidity varied from 50% to 68%. Eggs were gathered on five consecutive days and held for storage periods of 10, 20, 30, 40 or 50 days. Physical and microbiological examinations were made at the beginning of the trial and at the end of the designated storage periods. The results of this experiment indicate that including 10, 20, or 30% dehydrated poultry waste in the diet of hens had no significant deleterious effect on the quality of shell eggs as measured by Haugh units, storage weight loss, color, odor, and/or microbial content. (Miner-Iowa State)
W71-00930

THE EFFECT OF ANIMAL DENSITY AND SURFACE SLOPE ON CHARACTERISTICS OF RUNOFF, SOLID WASTES AND NITRATE MOVEMENT ON UNPAVED BEEF FEEDLOTS,
Nebraska Univ., Lincoln. Agricultural Experiment Station.
C. B. Gilbertson, T. M. McCalla, J. R. Ellis, O. E. Cross, and W. R. Woods.
Publication SB508, June 1970. 23 p, 5 fig, 7 tab, 23 ref.

Descriptors: *Rainfall-runoff relationships, *Chemical analysis, *Farm wastes, Chemical oxygen demand, Biochemical oxygen demand, Cattle, Laboratory tests, Detention reservoirs, Nitrates, Phosphorus.
Identifiers: *Dry matter removed (DMR), *Dry matter feces (DMF), Volatile solids, Feedlot slope, Cattle densities, Soil core samples, Feedlots.

The objectives of this study were to determine the effect of feedlot slope and cattle densities on: (1) The quantity and quality of runoff resulting from rainstorms and snowmelt, (2) Downward movement of pollutants into the soil profile on unpaved feedlots, and, (3) Amount of solids accumulation on the feedlot surface. Pairs of feedlots with 3, 6, and 9% slopes were installed. Ten and twenty cattle were placed in each pair of feedlots, which allowed 200 and 100 sq. ft. of area per animal. Volumetric measurement of runoff resulting from rainfall and snowmelt were made and samples of each runoff occurrence were taken to the laboratory for analysis. Laboratory analyses included pH, electric conductivity, total solids, non-volatile solids, total nitrogen, ammonium, nitrate, total phosphorus, COD and BOD. Soil cores were taken to depths of 14 ft. below the feedlot surface and adjacent buffer strips to determine downward movement of contaminants into the soil profile. Solids accumulations on the lot surface were removed twice. Weights of material removed were recorded and composite samples were taken to the laboratory for analyses. (Christenbury-Iowa State)
W71-00931

INFLUENCE OF POULTRY-MANURE-REMOVAL SCHEDULES ON VARIOUS DIPTERA LARVAE AND SELECTED ANTHROPOD PREDATORS,
California Univ., Berkeley. Dept. of Entomology and Parasitology.
John H. Peck, and John R. Anderson.
Journal of Economic Entomology, Vol 63, No 1, February 1970, p 82-90. 11 fig, 7 ref.

Descriptors: *Farm wastes, *Poultry, *Larvae, *Insect control, *Entomology, Vectors.
Identifiers: *Manure removal, *Diptera larvae, *Arthropod predators, Sampling, Control of flies.

The effects of weekly manure removal, monthly removal, and no removal on populations of fly larvae and slected predators (Acarina: Machrocheles muscaedomesticae Scopoli, Fuscuropods sp. (undescribed), Parasitidae; Coleoptera: Staphylinidae, Histeridaw, Hydrophilidae; Diptera: Ophyra leucostoma (Wiedemann) were studied for a full fly season at each of 2 northern California ranches. Third-instar larvae of the house fly, Musca domestica L., the false stable fly, Muscina stabulans (Fallen), and Calliphoridae were most abundant in 1-week-old manure; those of the little house fly, Fannia canicularis (L.), the coastal fly, Fannia femoralis Stein, and the black garbage fly, O. leucostoma, reached greatest numbers in 2- to 3-week-old manure. Unremoved manure had the least numbers of dipterous larvae, with the exception of the stable fly, Stomoxys calcitrans (L.). All predators studied were most abundant in unremoved manure. Abstention from manure removal favored the predators; monthly or biweekly removal favored the dipterous larvae. (Miner-Iowa State)
W71-00933

GROWTH RATE AS A MEASURE OF PRIMARY PRODUCTIVITY IN BENTHIC ALGAE,
Delaware Univ., Newark. Marine Lab.
Jonathan E. Taylor.
Cheasapeake Science, Vol 10, Nos 3 - 4, p 299-300, Sept.-Dec. 1969. 10 ref.

Descriptors: *Primary production, *Growth rates, Standing crop, Aquatic environment.
Identifiers: Benthic algae, Dry weight.

The rate of primary production is the amount of organic matter produced per unit time. The relation between estimates of growth rates and estimates of primary production is tenuous at best. The most accessible estimates of growth are harvest measurements of changes in the standing crop, but this depends on the destruction of the tissue. Less readily available in situ measurements are changes in linear dimension or surface area of the plant. Both techniques require independent estimates of respiration. (Upadhyaya-Vanderbilt)
W71-00972

THERMALLY INDUCED INTRACELLULAR ALTERATION OF RIBOSOMAL RIBONUCLEIC ACID,
Kansas State Univ., Manhattan.
Leonard J. Rosenthal, and John J. Iandolo.
Journal of Bacteriology, Vol 103, No 3, p 833-835, Sept 1970. 3 fig, 10 ref.

Descriptors: *Thermal pollution, Heat, Cultures, Degradation, Structure, Resistance.
Identifiers: Intracellular, Ribonucleic acid, Thermal pollution effects.

A rapid decay of ribonucleic acid (RNA) has been observed when living cells are exposed to elevated temperature 25C cultures of Staphylococcus aureus were grown and heated. Cell free extracts were prepared by suspending normal and heat treated cells in a lytic mixture. RNA was obtained from the crude extracts and whole cells by a modified phenol-dupanol method. Tritium labeled 23S RNA from heated and control cells was purified by sucrose gradient centrifugation. The control sample contained both 50 and 30S particles, whereas the heat treated preparation was essentially devoid of the 30S unit. Experiments have shown that the degradation of 30S particles varies from 85 to 100 per cent whereas the 50S particles appear intact. Polyacrylamide gel electrophoresis was used to fractionate normal and heated RNA preparations from both crude extracts and whole cells. Both molecular species of RNA were found in the extracts from untreated cells, but in the heated preparation 16S RNA was highly degraded and present only as a very small region. The extent of secondary structural differences in normal and heated 23S RNA was estimated by examining susceptibility to hydrolysis by pancreating ribonuclease. Normal 23S RNA contained 25.2 per cent resistant areas of helical configuration, whereas heated preparation was 16.6 per cent resistant. During heat shock unwinding at 23S RNA occurred. (Upadhyaya-Vanderbilt)
W71-00979

MASTEN V TEXAS CO (POLLUTION OF SUBSURFACE WATERS).
For primary bibliographic entry see Field 06E.
W71-00981

SCHLICHTKRULL V MELLON-POLLOCK OIL CO (ILLNESS CAUSED BY POLLUTION OF WELL).
For primary bibliographic entry see Field 06E.
W71-01028

EFFECTS OF ORGANIC ACIDS ON THE FLOCCULATION OF SUSPENDED SEDIMENTS IN TROPICAL MAN-MADE LAKES,
Ife Univ. (Nigeria).
For primary bibliographic entry see Field 02H.
W71-01062

5D. Waste Treatment Processes

A NOTE ON BACTERIAL GROWTH AROUND A RECHARGE WELL AT BAY PARK, LONG ISLAND, NEW YORK,
Geological Survey, Mineola, N.Y.
For primary bibliographic entry see Field 05C.
W71-00579

STUDIES ON LIMESTONE TREATMENT OF ACID MINE DRAINAGE, OPTIMIZATION AND DEVELOPMENT OF IMPROVED CHEMICAL TECHNIQUES FOR THE TREATMENT OF COAL MINE DRAINAGE.
Bituminous Coal Research, Inc., Monroeville, Pa.

Available from NTIS as PB-195 282, $0.95 in microfiche. Also for sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402. Price $1.25 SOD I67.13/4 DAST 33. Water Pollution Control Research Series DAST-33, 14010EIZ, 1/70. January, 1970. 96 p, 25 tab, 29 fig, 22 ref. FWQA Program 14010 EIZ, Grant 63-01-68.

Descriptors: *Mine drainage, *Neutralization, *Limestone, Oxidation, *Coal mine water, Iron oxides, Electrophoresis, Activated carbon, Sludge, Coagulation, Waste water.

Identifiers: Ferrous iron, Magnetic sludge.

Four actual coal mine waters have been neutralized with limestone both to a batch scale and by utilizing a continuous flow apparatus. Variations in treatment procedure were necessary depending on the characteristics of the individual waters. A standardized test was established to evaluate the reactivity of the limestone. The following variables are of importance in evaluating limestones for coal mine water neutralization: (a) particle size, (b) Ca and Mg content, and (c) surface area. Ferrous iron oxidation has been accomplished with both synthetic and actual coal mine water at low pH in the presence of coal-derived activated carbon. Electrophoretic mobility studies on procipitates obtained by both lime and limestone neutralization of coal mine water yielded information which can be applied for more effective sludge removal. Magnetic sludges were prepared using two different iron-bearing waters. The conversion of precipitates to a magnetic form results in significant reductions in settled sludge volumes as well as increases in solids content, compared to the initially formed sludge obtained by lime neutralization alone. Data obtained in these studies indicate that the limestone process offers considerable promise for an improved lower cost method for treating several types of coal mine waters.
W71-00620

CONTROLLING DEPOSITS IN COOLING-WATER SYSTEMS,
Nalco Chemical Co., Chicago, Ill.
For primary bibliographic entry see Field 08G.
W71-00642

DESIGN OF CONDENSER COOLING WATER SYSTEM FOR A NUCLEAR POWER PLANT LOCATED ON A LARGE ESTUARY,
Baltimore Gas and Electric Co., Md.; Johns Hopkins Univ., Baltimore, Md. Dept. of Geography; and Worcester Polytechnic Inst., Holden, Mass. Alden Research Lab.
F. J. Jeffers, J. C. Geyer, and L. C. Neale.
Transactions of the ASME, Vol 92, Series A, No 2, April 1970, p 150-156. 5 fig, 3 tab, 8 ref.

Descriptors: *Thermal pollution, *Cooling water, *Nuclear power plant, *Estuaries condensers, Tidal waters, Aquatic life, Solar radiation, Temperature, Model studies, Maryland.
Identifiers: Water quality standards, Chesapeake Bay, Momentum jet, Calvert Cliffs.

Electric generating capacity in the U. S. is continuing to increase at an exponential rate of growth. According to the Federal Power Commission the installed capacity on January 1, 1969, of 290,000 megawatts (MW) may reach 1,000,000 MW by 1990. The sun continuously supplies radiation to the whole earth at a rate of about 174 x 10 to the 9th power MW, which is estimated to be more than 10,000 times mankind's current total rate of fuel energy consumption. The mean monthly surface heat exchange coefficient, K, of the Chesapeake Bay during summer is about 45MW sq mi/F. From this it is estimated that for a temperature rise above ambient 1.5 F over the 3,000 square miles surface of the Bay, exclusive of tributary estuaries, the heat acceptance capacity is 220,000MW of waste heat. This is 64 times the amount of waste heat to be disposed of at Calvert site. Model tests which were carried out to determine the temperature distribution in the vicinity of the plant site and to assist in designing intake and discharge structures which would minimize any local adverse effects are described. Differences in performance of jet releases and low velocity releases as well as shoreline or off shore discharges were fully evident in the test results. (Upadhyaya-Vanderbilt)
W71-00653

HEAT AND MASS TRANSFER IN A CHANNEL WITH SURFACE MASS ADDITION: APPLICATION TO PHASE CHANGE PROCESSES,
Minnesota Univ., Minneapolis.
For primary bibliographic entry see Field 02D.
W71-00655

EARTHQUAKE DESIGN OF COOLING TOWERS,
University of Western Ontario, London. Dept. of Engineering Sciences.
For primary bibliographic entry see Field 08A.
W71-00656

SOME SPECULATIONS ON THE DEVELOPMENT OF NON-BIOLOGICAL METHODS OF SEWAGE TREATMENT,
Water Pollution Research Lab., Stevenage (England).
G. E. Eden.
Effluent and Water Treatment Journal, Vol 10, No 3, p 138-140, 142-146, 1970. 4 tab, 9 ref.

Descriptors: *Sewage treatment, Sludge disposal, Effluents, Coagulation, Sands, Filtration, Suspended load, Solid wastes, Biological treatment, Chemical precipitation, Oxidation, Nitrification, Distillation, Coals, Reverse osmosis, Ammonia, Lime, Aeration, Sulfates, Phosphates, Bicarbonates, Sodium, Potassium, Calcium, Hydrogen ion concentration, Organic compounds.
Identifiers: *Physico-chemical sewage treatment, Borate, Permanganate value, Anionic detergent.

Developments in the field of sewage treatment, indicating a tendency to supplement or replace traditional methods with processes having a closer relation to water treatment and water-reclamation practices, are presented. Recent innovations in sludge conditioning and incineration promise improvement in sludge disposal techniques. The traditional physico-biological procedure will remain the standard method of sewage treatment for major communities but will be improved with better understanding of basic microbiology of the processes. The following methods are suggested: optimization of sewage treatment for reclamation by a combination of high-rate biological treatment with chemical coagulation; treatment of crude sewage, intended primarily to produce an effluent low in phosphorus, first with lime and recycled sludge to precipitate most of the phosphate. Advantages and disadvantages of nonbiological processes for complete treatment of sewage are given in discussion of distillation, treatment of sewage using coal, high temperature oxidation of sewage, and chemical coagulation followed by reverse osmosis. (Jones-Wisconsin)
W71-00669

ELIMINATION OF CHLORAL FROM INDUSTRIAL EFFLUENTS BY ADSORPTION (IN RUSSIAN),
Institut Kolloidnoi Khimii i Khimii Body.
A. M. Koganovskii, and L. N. Gora.
Ukrainskii Khimicheskii Zhurnal, Vol 35, No 4, p 402-404, 1969. 1 fig, 3 tab, 3 ref.

Descriptors: *Industrial effluents, *DDT, *Waste water treatment, Separation techniques.
Identifiers: Charcoal, Chloral.

One of the introduced methods frees industrial effluents from the biologically undecomposable chloral by its adsorption by activated charcoal. Subsequently the charcoal is saturated with sodium hydroxide, a treatment which converts chloral into chloroform and sodium formate. The formate solution is biologically oxidized, whereas chloroform is extracted by water vapor. In the second method, chloral is converted to chloroform and formate by an addition of lime and alkali to the effluent. The latter is then passed through activated charcoal and the regeneration is accomplished by a stream of vapor. The effluent of the plants manufacturing DDT contains from 2 to 30 gallon/liter of chloral, the presence of which precludes biological purification. (Wilde-Wisconsin)
W71-00675

SANITARY SEWERAGE FACILITIES IN UNION COUNTY.
Union County Planning Board, N.J.
For primary bibliographic entry see Field 05G.
W71-00786

AN EXPERIMENT ON THE STERILIZATION OF WATER WITH ULTRAVIOLET RAYS,
Bureau of Commercial Fisheries, Washington, D.C. Office of Foreign Fisheries.
V. I. Laptev.
Trans. from Pishchevaya Promysh. Vol 15, 1967. Available from NTIS as PB-192 870T, $3.00 in paper copy, $0.95 in microfiche. Free Translation, March 1970. 4 p.
Identifiers: *Fishes, Industries, *Water, Sterilization, *Parasites, *Ultraviolet radiation, Pest control, Tests, USSR.

For sterilization of the water of cercariae, and also parasitic protozoans, experiments were performed in the laboratory on the effect of ultraviolet rays (UV-rays) on free-living infusoria, parasitic protozoans and non-specific cercariae. First the effect of UV-rays on Chilodonella cyprini, Trichodina sp., Paramecium caudatum, Cercaria sp. in standing water were studied; then several tests with cercariae in flowing water, utilizing the bactericidal apparatus were performed.
W71-00821

WATER AND SEWERAGE STUDY - FIRST PHASE.
Morris County Planning Board, Morristown, N.J.
For primary bibliographic entry see Field 05G.
W71-00831

OIL AND HAZARDOUS MATERIALS CONTINGENCY PLAN FOR PREVENTION, CONTAINMENT AND CLEANUP FOR THE STATE OF MAINE,
Portland Harbor Pollution Abatement Committee, Maine.
For primary bibliographic entry see Field 05G.
W71-00853

CONTINUOUS CATALYTIC DECOMPOSITION OF METHANE,
Battelle Memorial Institute, Columbus, Ohio.
B. C. Kim, J. Zupan, L. Hillenbrand, and J. E. Clifford.
Available from NTIS as NASA CR-1662, $3.00 in paper copy, $0.95 in microfiche. National Aeronautics and Space Administration Contractor Report NASA CR-1662, October, 1970. 63 p, 12 tab, 26 fig, 5 ref, 2 append. Contract NAS 2-5051.

Descriptors: *Methane, *Carbon, Oxygen, *Carbon dioxide, Etrolysis.
Identifiers: *Methane decomposition, Methane cracking, Carbon separation, Reactor design.

Experimental studies of catalysts for decomposition of methane and process design studies were directed to the problems of carbon production in a high-temperature reaction required for one subsystem of the Closed Sabatier system as applied to space life support. The basis for a new reactor design for continuous carbon removal in a gravity-independent manner was demonstrated using a rotating magnetic field to support the catalyst in the flowing methane stream and to confine the catalyst bed within the high-temperature reaction zone until a high catalyst utilization is achieved. For this purpose, the preferred catalyst was cobalt power which maintains magnetic properties above the desired reaction temperature of 850 C. On the basis of the experimental data obtained, a methane-decomposition reactor having a catalyst-bed volume of about 1 liter was designed for a nominal 3-man system.
W71-00909

SWINE HOUSING AND WASTE MANAGEMENT - A RESEARCH REVIEW,
National Pork Producers Council; Illinois Univ., Urbana. Coll. of Agriculture.
For primary bibliographic entry see Field 05G.
W71-00924

PONDS STOP POLLUTION FROM FEEDLOTS,
Soil Conservation Service, Salina, Kans.
For primary bibliographic entry see Field 05B.
W71-00925

LABOR-FREE MANURE DISPOSAL,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
Rex Wilmore.
Farm Journal, Vol 93, No 8, August 1969, p 26C-26D. 1 fig.

Descriptors: *Farm wastes, *Aeration, *Lagoons, Aerobic bacteria, Effluent, Sprinkler irrigation, Storage capacity, Water pollution, Odors, Efficiencies, Slurries, Oxygen, Organic matter, Pumps, Labor, Costs, Management.
Identifiers: *Floating aerator, Suspended solids, Volatile solids.

Research at Purdue University indicates that a floating aerator in a lagoon can provide a low cost system that promises to avoid pollution dangers and saves labor. Manure is dumped into the lagoon once each day although it is better to have it continuously trickle in. Extra water is added to bring the solids content down to 2% or 3% for top efficiency. The aerator, a big doughnut-like float with an electric motor on top driving an impeller, runs continuously. The impeller forces a spray of slurry up over the float, mixing air into the lagoon, so aerobic bacteria can break down manure without odors. Periodically a small pump pulls out some of the mixed slurry and sprinkles it through a 'big gun' type nozzle onto grassland. The irrigation lowers the lagoon, which allows more water dilution and removes the suspended solids that won't decompose. Other advantages include low labor cost as compared to pits and spreaders, and minimal management. Its biggest disadvantage might be getting the manure into the lagoon each day. (White-Iowa State)
W71-00927

TREATMENT OF DAIRY MANURE BY LAGOONING,
Washington State Univ., Pullman.
Surinder K. Bhagat, and Donald E. Proctor.
Journal Water Pollution Control Federation, Vol 41, No 5, 1969, p 785-795. 9 fig, 7 tab, 6 ref.

Descriptors: *Farm wastes, *Farm lagoons, *Biodegradation, Algae, Biochemical oxygen demand, Anaerobic digestion, Aerobic treatment, Chemical oxygen demand, Storage capacity, Effluents, Construction.
Identifiers: *Dairy manure, Total solids, Volitile solids, Non-degradable solid.

Because of high solids content of dairy manure waste, anaerobic lagoons can be used satisfactorily as a primary waste treatment. Average removals of BOD, COD, TS, and VS above 86 percent can be accomplished with an applied loading of 70 lb VS/day/1000 Cu. Ft. (1120 g/day/cu. m.). An anaerobic lagoon can act as a sedimentation, flotation, and anaerobic digestion process unit while simultaneously providing long-term storage for non-degradable solid residue. The effluent from the anaerobic lagoon retains most of the nutrients present in the raw manure waste and thus has fertilizer value. The effluent has organic matter which can be oxidized. The effluent can be applied to a field or subjected to further treatment. The secondary treatment can be an aerated lagoon, oxidation ditch, or an oxidation pond. The results of the batch type aerobic treatment indicated that an effluent BOD at 20 mg/l can be achieved by a 24-hr. aeration period. (Christenbury-Iowa State)
W71-00936

NATURAL FILTERS FOR AGRICULTURAL WASTES,
Soil Conservation Service, Washington, D.C.
W. E. Bullard, Jr.
Soil Conservation, Vol 34, No 4, November 1968, p 75-77. 2 fig.

Descriptors: *Farm wastes, *Sprinkler irrigation, *Organic wastes, *Waste water disposal, Air pollution, Water pollution, Odor, Effluents, Sewage effluents, Dilution, Decomposing organic matter, Insects, Mites, Bacteris, Fungi, Algae, Nitrites, Nitrates, Detergents, Phosphates.
Identifiers: *Biologic 'disposers', Microscopic organisms, Papermill waste effluent, Cheese factory waste waters.

Farmers and processors of farm products are finding that the waste products of their operations generally can be returned to the land with less hazard to the environment than when discharged into streams. By completing the natural cycle of growth, death, and decay on the land where crops are produced they make use of a legion of 'disposer' organisms in the soil capable of decomposing organic wastes on site. When sprayed on grass or crops, the effluent serves the dual purpose of irrigating and fertilizing the field, thus, agriculture has the potential means of disposing of its own wastes and preventing or reducing environmental pollution. Numerous examples are given of returning sewage treatment effluents, pulp and papermill effluents, and cheese factory waste waters, among others, to the land by sprinkler irrigation. The principle behind these successful operations is that of getting material produced from the land back onto the land where they can be used again in production. (White-Iowa State)
W71-00940

TREATMENT OF BEEF-CATTLE WASTE WATER FOR POSSIBLE REUSE,
North Dakota State Univ., Fargo.
G. L. Pratt, R. E. Harkness, R. G. Butler, J. L. Parsons, and M. L. Buchanan.
Transactions of the ASAE, Vol 12, No 4, 1969, p 471-473. 2 fig, 3 tab, 19 ref.

Descriptors: *Farm wastes, *Cattle, *Septic tank, Biochemical oxygen demand, Chemical oxygen demand, Hydrogen ion concentration, Effluents, Aeration, Dissolved oxygen, Turbidity, Aluminum.
Identifiers: *Settling tank, *Slatted floor, *Reuse, Total solids, Volatile solids, Aluminum sulfate.

Removing solid materials from wastes that have been washed from a livestock barn with water can be accomplished in several ways. In trials at the North Dakota Agricultural Experiment Station settling tanks were evaluated. Treatments of overflow from the settling tank by aeration and chemical coagulation were compared with settling only. The equipment consisted of an 8x8 foot animal shelter with a steel-slatted floor. Manure was washed from under the floor to a settling tank. A secondary treatment tank was installed to receive overflow from the settling tank. A pump end holding tank was used so that the effluent from the secondary treatment tank could be used in washing the floor under the steel slats. Aeration and treatment with alum did not upgrade the waste water sufficiently to make the water odorfree. It was also colored. Other treatment will be needed to remove the odor before the water can be suitable for reuse in washing the building. (White-Iowa State)
W71-00942

STABILITY OF HYPERBOLOIDAL COOLING TOWER,
Uillinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics; and Marley Co., Kansas City, Mo.
For primary bibliographic entry see Field 08A.
W71-00984

5E. Ultimate Disposal of Wastes

NEED FOR SALINE GROUNDWATER DATA TO ADVANCE DESALTING TECHNOLOGY,
Office of Saline Water, Washington, D.C.
For primary bibliographic entry see Field 03A.
W71-00570

DEEP WELL DISPOSAL OF WASTE WATERS IN SALINE AQUIFERS OF SOUTH FLORIDA,
Black, Crow and Eidsness, Inc., Gainesville, Fla.; and Geological Survey, Tallahassee, Fla.
Jose I. Garcia-Bengochea, and Robert O. Vernon.
Water Resources Research, Vol 6, No 5, p 1464-1470, October 1970. 7 p, 4 fig, 1 tab, 5 ref.

Descriptors: *Aquifers, *Injection wells, *Florida, Waste disposal, Industrial wastes, Saline water systems, Limestones, Karst, Confined water, Groundwater movement, Regulation, Water law, Hydrogeology, Monitoring, Sampling, Brines, Acids.
Identifiers: Waste disposal wells.

Florida is underlain by very rich water-bearing strata called the Floridan aquifer. Solution channels and caverns in carbonaceous rocks are found at different depth intervals in extensive, thick (several thousand feet) sections of limestones and dolomites. In south Florida the bottom part of the Floridan aquifer includes extremely cavernous strata, commonly referred to as the 'Boulder Zone.' Chloride concentration in the water of the Boulder Zone is over 2000/mg liter. Because of this, large volumes of brine from oil fields are reinjected into this zone. Since 1966 industrial waste (essentially 1% acetic acid) has been injected into a disposal well drilled to the top of the Boulder Zone southeast of Lake Okeechobee. Planning and monitoring of this well have included the cooperation of government and private interests. Experiences, results, and potential of this zone for further similar uses are discussed. (Knapp-USGS)
W71-00573

WATER SUPPLY AND SEWAGE DISPOSAL.
Rensselaer County Dept. of Planning and Promotion, Troy, N.Y.
For primary bibliographic entry see Field 03D.
W71-00828

ENVIRONMENTAL SIMULATION AS A TOOL IN A MARINE WASTE DISPOSAL STUDY OF JAMAICA BAY,
Rand Corp., Santa Monica, Calif.
For primary bibliographic entry see Field 05G.
W71-00830

RADIOACTIVE WASTE DISPOSAL BY HYDRAULIC FRACTURING,
Oak Ridge National Lab., Tenn.
Wallace de Laguna.
Industrial Water Engineering, Vol 7, No 10, p 32-37, October 1970. 6 p, 4 fig, 9 ref.

Descriptors: *Injection wells, *Radioactive waste disposal, *Fractures (Geology), *Shales, *Grouting, Hydrogeology, Permeability, Cement grouting, Clays, Concretes, Leakage.
Identifiers: Hydraulic fracturing (Underground), Waste disposal wells, Waste injection wells.

Nuclear fuel reprocessing plants produce about 1300 to 5200 gal per day of intermediate waste. This material, and the sludges from the low-level waste treatment, are suitable candidates for disposal by hydraulic fracturing in areas where the geology is favorable for such operations. Waste disposal by hydraulic fracturing requires much the same procedure and equipment as oil-well stimulation. Once rock fracturing and flow down the injection well are established, Portland cement and clay,

and possibly other additives are mixed into the stream of water. The liquid feed is then switched to the radioactive waste, and the waste, also mixed with the proper proportion of solids, is pumped down the well until the waste tanks are empty. The liquid feed is then switched back to water until the remaining solids are all used up, and finally is pumped down the well to flush it and the slot clear of cement. The well is then shut in until the cement has set and the waste-cement-clay mixture converted into a thin layer of artificial rock embedded in depth in the shale. (Knapp-USGS)
W71-00882

LABOR-FREE MANURE DISPOSAL,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 05D.
W71-00927

CONTROL OF HOUSE FLIES IN SWINE-FINISHING UNITS BY IMPROVED METHODS OF WASTE DISPOSAL,
Purdue Univ., Lafayette, Ind. Dept. of Entomology.
For primary bibliographic entry see Field 05G.
W71-00932

5F. Water Treatment and Quality Alteration

THE FLOTABILITY OF CZECHOSLOVAKIAN ION-EXCHANGE RESINS (IN CZECHOSLOVAKIAN),
Kosice Univ. (Czechoslovakia). Dept. of Chemistry.
Anna Sopkova.
English summary. Chemicke Listy, Vol 63, No 5, p 596-609, 1967. 8 fig, 7 tab, 14 ref.

Descriptors: *Resins, *Ion exchange, *Flotation, *Water treatment, Water conditioning.
Identifiers: Crosslinkage, Copolymers, pK values, Katex, Anex, Thiocarbonates, Alkylsulphates, Czechoslovakia.

The flotability of Czechoslovakian exchange resins (Katex S, Katex KM, Anex S and TM, and Anex S 8D) was compared with that of the foreign products (Dowex, Ira, Permutit, Biorex, SAR, Sar, AG, and AV). The flotability of the resins was observed in hydrogen ions and hydroxide forms, in combination with chlorine and divalent copper, and in a suspension containing 50% solid particles. The results confirmed that the flotability of exchange resins depends upon their hydrophobility and the dissocication of the attached polar groups. The resins of Czechoslovakian production exhibited a fair degree of flotability, but some of them required a higher percentage of copolymers than do resins of foreign origin. (Wilde-Wisconsin)
W71-00679

ELIMINATION OF PETROLEUM REFUSE BY A PRODUCT HARMLESS TO AQUATIC FLORA (IN FRENCH),
Laboratoire de Cryptogamie du MNHN, Paris (France); Bureau de Recherches Geologiques et Minieres, Loiret (France); Institut Oceanographique, Paris (France); Laboratoire Maritime du MNHN, Ille-et-Vilaine (France); Fondation Curie, Paris (France) Laboratoire de Genetique.
Pierre Fusey, Juan Goni, Jean-Claude Lacaze, Marie-Louise Priou, and Jacqueline Lamidey.
Comptes Rendus Academie des Sciences, Paris, Vol 269, No 24, Serie D, p 2435-2438, 1969. 3 fig, 5 ref.

Descriptors: *Emulsifiers, *Oil wastes, *Dispersion, Water pollution control, Sea water, Toxicity, Laboratory tests.
Identifiers: Oil spills, Hydrocarbons, Petroleum wastes.

An unidentified commercial product, composed of carbohydrates (saccharose and glucose) and phosphoric acid was tested as an emulsifier and disperser of petroleum in water. The compound has a specific gravity of 1.596. It is introduced to petroleum spills by simple mechanical dispersion, is suitable for all waters, and remains stable in pH range of 1.8-8.0. It is 62 times less toxic than the products used since the Torrey Canyon oil spill. It has slight effect on micro-communities of marine algae in application below 0.05 cubic centimeter/liter; cultured marine ecosystems showed no effects in media containing pollutant and 0.04 cubic centimeter/liter of the compound. Marine fish displayed no apparent detrimental effects after 6-hour exposure of 0.12 cubic centimeter/liter of the product. Shrimp tolerated concentrations of 0.30 cubic centimeter/liter; mussels were unable to tolerate concentrations above 0.12 cubic centimeter/liter. These concentrations exceeded requirements for dispersion and emulsification of petroleum. Laboratory mammals showed no deleterious effects. Comparison of chromatograms after 3 months at laboratory temperature indicated that petroleum disappeared almost entirely from solution. The problems of residual sludge of sea transport, beach pollution and harbor installations may be overcome by this compound. (Auen-Wisconsin)
W71-00681

HUMAN WASTE SANITATION STUDIES,
Truesdail Labs., Inc., Los Angeles, Calif.
For primary bibliographic entry see Field 05G.
W71-00814

AN EXPERIMENT ON THE STERILIZATION OF WATER WITH ULTRAVIOLET RAYS,
Bureau of Commercial Fisheries, Washington, D.C. Office of Foreign Fisheries.
For primary bibliographic entry see Field 05D.
W71-00821

WATER AND SEWERAGE STUDY - FIRST PHASE.
Morris County Planning Board, Morristown, N.J.
For primary bibliographic entry see Field 05G.
W71-00831

PRELIMINARY EVALUATION OF AVAILABILITY OF POTABLE WATER ON ELLIOTT KEY, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 03B.
W71-00881

5G. Water Quality Control

STORM WATER POLLUTION FROM URBAN LAND ACTIVITY, DEVELOPMENT OF ANALYTICAL PROCEDURES FOR PREDICTING STORM WATER POLLUTION FROM URBAN AREAS BY USE OF SELECTIVELY DEFINED URBAN CHARACTERISTICS.
Avco Economic Systems Corp., Washington, D.C.
For primary bibliographic entry see Field 05A.
W71-00619

STUDIES ON LIMESTONE TREATMENT OF ACID MINE DRAINAGE, OPTIMIZATION AND DEVELOPMENT OF IMPROVED CHEMICAL TECHNIQUES FOR THE TREATMENT OF COAL MINE DRAINAGE.
Bituminous Coal Research, Inc., Monroeville, Pa.
For primary bibliographic entry see Field 05D.
W71-00620

DYNAMIC MODEL STUDY OF LAKE ERIE, PART I. SIMILITUDE CRITERIA AND EXPERIMENTAL SET-UP,
State Univ. of New York, Buffalo. Faculty of Engineering and Applied Sciences.
For primary bibliographic entry see Field 02H.
W71-00621

DYNAMIC MODEL STUDY OF LAKE ERIE, PART II, ANALYTICAL AND EXPERIMENTAL RESULTS,
State Univ. of New York, Buffalo. Faculty of Engineering and Applied Sciences.
For primary bibliographic entry see Field 02H.
W71-00622

FEASIBILITY OF A PERIODIC FLUSHING SYSTEM FOR COMBINED SEWER CLEANSING.
FMC Corp., Santa Clara, Calif. Central Engineering Labs.

Available from the NTIS as PB-195 223, $3.00 in paper copy, $0.95 in microfiche. Final Report - Phase I, CE45363, August, 1967. 48 p, 1 tab, 11 fig, 23 ref, 4 drawings. FWQA Program 11020D-NO08/67.

Descriptors: Sewers, Overflow, Conveyance structures, Storm drains, Water pollution control, Costs, Flow.
Identifiers: *Combined sewers, *Storm water overflow, *Flushing systems, *Sewer flushing, Sewer cleansing.

One of the causes of pollution from stormwater overflow of combined sewers is the deposition of pollutional solids during dry weather flow followed by pick up of the pollutional material during storm flow when the flow be bypassed. As a solution to this problem, it has been proposed that a flushing system be used to periodically cleanse the sewers during dry weather and convey the solids to the treatment plant. Under Phase I a study was made of sewer flushing practices, application requirements, and hydraulic theory. Investigation was also made of sampling methods and equipment; flushing test equipment was designed for use in Phase II, and the cost of Phase II was estimated. It was confirmed that additional detailed information is needed to apply a periodic flushing system to actual combined sewers. It was also concluded that the existing information on sewer flushing indicated a good possibility that a periodic flushing system would be feasible for reducing pollution from combined sewer stormwater overflow. The detailed information needed to apply a sewer flushing system must be determined by a large number of controlled experiments of flushing effectiveness. The design of flushing evaluation equipment for use in Phase II has been carried to the point that cost estimates can be made for construction of the equipment. A description of the design and the cost estimates are included in this report.
W71-00623

STREAM POLLUTION IN THE 'NEW LEAD BELT' OF S.E. MISSOURI,
Missouri Water Resources Research Center, Columbia.
For primary bibliographic entry see Field 05C.
W71-00627

ARTIFICIAL MIXING OF STRATIFIED FLUIDS FORMED BY SALT AND HEAT IN A LABORATORY RESERVOIR,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
Lucien M. Brush, Jr.
Available from NTIS as PB-195 308, $3.00 in paper copy, $0.95 in microfiche. New Jersey Water Resources Research Institute, Rutgers University, New Brunswick, Sept. 1970. 37 p, 2 tab, 7 fig, 19 ref, append. OWRR Project B-024-NJ (1).

Descriptors: *Lakes, *Mixing, *Water quality, *Stratification, Reservoirs, Thermal properties, Density stratification, Water temperature.
Identifiers: *Destratification, Interfacial entrainment.

Destratification of a two-layer reservoir by pumping fluid from one layer and jetting the discharge into the other was studied in the laboratory. The fluid layers were formed by hotwater - coldwater and saltwater - freshwater combinations. For a particular range of Richardson no., thermally stratified fluids mixed more readily than those formed by saline solutions indicating a greater interfacial entrainment rate. Although these differences may be influenced by molecular diffusivity as suggested by Turner, it is felt that there is at least one alternate explanation involving local viscous effects near the interface. The results of the study show agreement with previous laboratory investigations involving different geometric arrangements, and with two field studies of mixing in thermally stratified lakes. Insufficient field evidence exists for establishing precise model-prototype relationships, but the overwhelming dominance of the Richardson no. (or densiometric Froude no.) as a dynamic control is evident. (Whipple-Rutgers)
W71-00632

HOWELL V CITY OF DOTHAN (ABATEMENT OF NUISANCE CAUSED BY MUNICIPAL WASTES).
For primary bibliographic entry see Field 06E.
W71-00638

PROCEEDINGS, CONFERENCE (ON) POLLUTION OF LAKE SUPERIOR AND ITS TRIBUTARY BASIN, MINNESOTA-WISCONSIN-MICHIGAN, DULUTH, MAY 13-15, 1969; EXECUTIVE SESSION SEPTEMBER 30-OCTOBER 1.
Federal Water Pollution Control Administration.

(1970), 4 volumes,

Descriptors: *Water quality, *Water quality control, *Legislation, *Lake Superior, *Administration, Minnesota, Wisconsin, Michigan, Water pollution sources, Water pollution control, Water pollution effects, Water policy, Commercial fishing, Eutrophication, Standards, Population, Water utilization, Legal aspects, Water law, Land use, Economics, Surveys, Public health, Mine wastes, Recreation wastes, Municipal wastes, Industrial wastes, Waste treatment.
Identifiers: *Hearings, Waterborne commerce.

Hearings and testimony, analyses, and evaluations by federal, state, and local agencies, industries, and citizen groups were held in connection with the pollution of Lake Superior and its interstate tributary basin. The effects of taconite tailings, treated and untreated municipal and industrial wastes, watercraft, and oil discharges on the lake's ecology were documented. Reports of bacterial pollution in the St Louis River, Duluth Harbor and Superior Harbor areas, Ashland inshore reaches, and the Montreal River (Wisconsin) are presented. Among the many problems discussed were land use practices, continued surveillance of taconite tailings discharges, secondary biological waste treatment by all municipalities, continuous disinfection of treatment plant effluents, phosphorus reduction by 80%, unified collection systems serving contiguous urban areas, prohibition of combined sewers, discharge of treatable industrial wastes to municipal systems, and usage of low pesticide concentrations. (Auen-Wisconsin)
W71-00643

CANALS OFFER VAST COOLING POTENTIAL.

Environmental Science and Technology, Vol 4, No 4, April 1970.

Descriptors: Thermal pollution, Cooling water, Temperature, Evaporation, Recreation, Thermal capacity.
Identifiers: Cooling canals, Heat sink.

The principal objective of the canal lake system is provision of an extended heat sink away from the public water courses, capable of supporting power stations all along its route, with reuse of the water as many times as practical. Many of the locations in the U. S. have the potential for such development. To illustrate the potential of canal lake cooling systems, researchers have applied the concept to one of the routes suggested for a major diversion project in the northwest. This proposed 990 mile diversion would begin in Oregon, pass through northwestern California and Nevada via a series of natural lakes and man-made canals, and eventually discharge into Lake Mead. The thermal capacity of this system could support up to 30,000 Mw of generating capacity. Restraints on the system are the following: No temperature rise greater than 5C and surface temperature no higher than 32C at any point. System would also provide recreational facilities to water short areas without distracting from the basic purpose of the system. (Upadhyaya-Vanderbilt)
W71-00659

AMITROLE RESIDUES AND RATE OF DISSIPATION IN IRRIGATION WATER,
Agricultural Research Service, Denver, Colo. Crops Research Div.; and Agricultural Research Service, Prosser, Wash. Crops Research Div.
For primary bibliographic entry see Field 03F.
W71-00698

SYSTEMS APPROACH TO THE EVALUATION OF BENEFITS FROM IMPROVED GREAT LAKES WATER QUALITY,
Illinois Univ., Urbana. Dept. of Civil Engineering.
D. D. Meredith, and B. B. Ewing.
Proc 12th Conf Great Lakes Res, Internat Assoc Great Lakes Res, Braun-Brunfield, Inc, Ann Arbor, Mich, p 843-870, 1969. 28 p, 8 fig, 2 append, 29 ref.

Descriptors: *Systems analysis, *Benefit-cost analysis, *Water quality control, *Mathematical models, *Great Lakes, *Evaluation, Pollution abatement.

A systems approach to the evaluation of benefits that would accrue due to an improvement in the water quality of the Great Lakes due to pollution abatement practices was outlined. Data pertaining to the problem was gathered and a review of literature on water resources benefit evaluation was made. The basic approach for analysis of municipal and industrial water supply, recreational use, and commercial fishing involved following a change in water quality through a sequence of interrelationships to arrive at an estimate of annual benefits. The five steps to a systems analysis approach were given and a mathematical model which could be solved to determine the benefits for a change in water quality when the level of water quality before and after improvement is known was presented in the appendix. This conceptual model for benefit-cost analysis divided a lake into a number of sectors in which strong water quality interrelationships existed and water quality was influenced more by what occurred in the sector than by neighboring sectors. Sectors were defined by major water uses and water quality variables were listed. The model was said to be applicable to all uses. (Kriss-Cornell)
W71-00707

POLLUTION, PURIFICATION AND THE THEORY OF EXTERNAL EFFECTS,
Stockholm Univ., Sweden.
For primary bibliographic entry see Field 06C.
W71-00752

SANITARY SEWERAGE FACILITIES IN UNION COUNTY.
Union County Planning Board, N.J.

Available from NTIS as PB-192 835, $3.00 in paper copy, $0.95 in microfiche. April 30, 1969. 66 p.

Identifiers: *Management planning, New Jersey, *Sanitary engineering, Sewage, Test facilities, Wastes (Industrial), Collecting methods, Structures, Fluid flow, Construction, Storage, Chemicals, Diagrams, Maps, Statistical data, Costs, Effectiveness, *Union County (NJ), Area planning and development, *Sewage facilities.

Union County, like most of the more densely developed and populated counties in northeast New Jersey, has been provided with large, comprehensive regional collection and treatment systems. These regional facilities were created in the past by the municipalities who had the foresight and who were endeavoring to seek the most efficient, effective and economical method of collection treatment. A brief history of the development of sanitary sewer facilities in the County will illustrate how regionalization occurred.
W71-00786

AREAWIDE WATER AND SEWER PLAN: COMPREHENSIVE PLANNING STUDY, CROSSETT, ARKANSAS.
Crossett Ashley County Joint Planning Commission, Ark.

Available from NTIS as PB-193 516, $3.00 in paper copy, $0.95 in microfiche. June 1970. 20 p. HUD Project ARK P-84.
Identifiers: *Sewage, Disposal, *Sanitary engineering, Arkansas, Drainage, Costs, Water supplies, Population, *Area planning and development, *Crossett (Ark), *Sewers, Sewage treatment facilities.

The purpose of the report is to plan for future water and sewer needs for the urban area of the City of Crossett, Arkansas. The plan is based on projected growths for 5-year and 25-year programs.
W71-00788

SEWER AND WATER FACILITIES ANALYSIS.
Capital District Regional Planning Commission, Albany, N.Y.

Available from NTIS as PB-193 332, $3.00 in paper copy, $0.95 in microfiche. July 1970. 45 p. HUD Project NYP 184.
Identifiers: *Management planning, Water supplies, Statistical analysis, *Sanitary engineering, *New York, Rural areas, Sewage, Site selection, Dams, Wastes (Sanitary engineering), Disposal, Tables, Maps, Area planning and development.

Inventory and analysis of both existing and planned public water systems and sewerage systems in the four-county region. The adequacy of water supply and sewerage planning in each county to qualify for initial HUD certification has been evaluated. Additional planning considerations are pointed out if the planning in any area is not adequate. Maps are developed to show the locations of existing and planned water and sewer facilities and the service area of each system. Pertinent data of each system are also collected and summarized in tables.
W71-00790

RICHMOND REGIONAL SEWERAGE PLAN. AREA WIDE PLAN FOR LONG RANGE DEVELOPMENT, TECHNICAL DATA.
Richmond Regional Planning District Commission, Va.

Available from NTIS as PB-192 438, $3.00 in paper copy, $0.95 in microfiche. April 1970, 15 p, tab, fig.
Identifiers: *Urban areas, Sanitary engineering, *Sewerage, *Management planning, Data, Fluid flow, Volume, Pipes, Design, Disposal, Virginia, *Regional planning and development, Richmond, Virginia, Sewage pipes, *Sewerage disposal, Sewerage treatment.

The volume consists of tabulated sewage flows by demand zones and other supplementary technical data pertinent to the basic report.

W71-00805

DU PONT PLANTS EFFLUENT DISPERSION IN DELAWARE RIVER: HYDRAULIC MODEL INVESTIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 05G.
W71-00813

DU PONT PLANTS EFFLUENT DISPERSION IN DELAWARE RIVER: HYDRAULIC MODEL INVESTIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Available from NTIS as AD-706 216, $3.00 in paper copy, $0.95 in michrofiche. May 1957. 19 p, plates, illus, tabs. Miscellaneous Paper No. 2-222.
Identifiers: *Power plants (Establishments), Water pollution, *Water pollution, Hydraulic models, Floods, Wastes (Industrial), Scattering, River currents, Tides, Rivers, Delaware. Delaware River.

Deepwater Point and Carneys Point Plants of the du Pont Company, located on the New Jersey shore of the Delaware River are presently discharging high-acidity, high-density by-products from two retention basins through tide-controlled sluice gates into the Delaware River. The sluice gates open during times of ebbing currents and close during times of flooding currents. Currents adjacent to the shore line in the vicinity of the discharge points are low, and the plant effluents are not being rapidly and efficiently dispersed throughout the river water passing the plants. Effluent concentrations in all small embayments and pockets along the New Jersey shore are at time higher in the vicinity of the plants than elsewhere along the shore line. To alleviate this situation it was proposed that the present method of releasing effluent intermittently through the two tidal sluice gates be changed to a continuous release method utilizing pipes extending into the river along the channel bottom.
W71-00813

HUMAN WASTE SANITATION STUDIES,
Truesdail Labs., Inc., Los Angeles, Calif.
Clyde L. Blohm.
Available from NTIS as AD-706 931, $3.00 in paper copy, $0.95 in microfiche. Final Report, May 1965. 44 p. OCD-DS-63-235.
Identifiers: *Fallout shelters, *Wastes (Sanitary Engineering), Odors, Control, Sodium compounds, Sulfates, Copper compounds, Oleic acids, Mineral oils, Chemicals, Costs, *Odor control, Copper sulfates, Sodium bisulfate.

Investigations were made of the handling and storage of human wastes as they might be encountered under occupancy conditions in Office of Civil Defense fallout shelters. A chemical sanitizing and odor control agent has been selected from a number tested. This preferred agent is a simple physical mixture of two parts sodium bisulfate and one part copper sulfate pentahydrate, used in the waste container at the concentration of one pound per ten gallons (12,000 ppm) of accumulated wastes. One pint of oleic acid (commercial red oil) may or may not be used as a vapor barrier to improve odor control. General criteria have been established for the specification of such control agents which may be other than the one selected. Design studies were conducted for the fabrication of a Sanitary Vault intended for use in fallout shelters. The vault is equipped with two seats and has a useable fill volume of 70 gallons of mixed wastes. Four prototype units were constructed for testing. Recommendations for further work have been made.
W71-00814

RECOMMENDED REGIONAL PLAN FOR SEWERAGE, WATER SUPPLY AND STORM DRAINAGE.
Valley Regional Planning Agency, Ansonia, Conn.
For primary bibliographic entry see Field 06B.
W71-00819

STORM DRAINAGE: INVENTORY AND ANALYSIS OF MAJOR EXISTING AND PLANNED FACILITIES. VOLUME V: STORM DRAINAGE.
Valley Regional Planning Agency, Ansonia, Conn.
For primary bibliographic entry see Field 06B.
W71-00820

WATER SUPPLIES AND WATER FACILITIES IN UNION COUNTY.
Union County Planning Board, N.J.
For primary bibliographic entry see Field 03D.
W71-00826

WATER SUPPLY AND SEWAGE DISPOSAL.
Rensselaer County Dept. of Planning and Promotion, Troy, N.Y.
For primary bibliographic entry see Field 03D.
W71-00828

MANAGING THE NATURAL ENVIRONMENT: A REGIONAL PLAN FOR WATER, SEWAGE, AIR AND REFUSE,
Tri-State Transportation Commission, New York.
Richard S. DeTurk.
Available from NTIS as PB-190 290, $3.00 in paper copy, $0.95 in microfiche. March 1970. 38 p. HUD Project INT P-221.
Identifiers: *Water pollution, Control, *Air pollution, Environment, Sewage, Wastes (Sanitary Engineering), Wastes (Industrial), Water supplies, Passenger vehicles, Generators, Heaters, Incinerators, Connecticut, Sea water, Purification, Desalination, Costs, Urban areas, New Jersey, New York, Sources.

The Tri-State Region Connecticut, New Jersey, New York, should invest $9.7 billion between now and 1985 to contend with its environmental problems: lack of water, dirty air, polluted streams and overflowing garbage dumps. For more water the Region should tap more sources in the countryside and make better connections between neighboring water-supply systems. For cleaner waterways, vast spending for sewage-treatment plants is required to treat industrial and residential wastes. This will require federal assistance beyond what has been offered in the past. For cleaner air, the Region needs further tightening of pollution controls to counteract increasing numbers of polluters: motor vehicles, home heating units, generating stations and incinerators. And refuse disposal requires a changeover from dumping and burying to high-grade incineration. A network of 70 to 80 incinerators should be planned and built. Other methods for gathering water, such as desalinating sea water, purifying and reusing sewer water, and damming Long Island Sound or the Hudson River, are not appropriate at this time. Also, the Region cannot count on the appearance of electrically powered autos to stem air pollution, nor can enough remote areas be found to accept massive amounts of hauled garbage from developed areas. But tests should be encouraged to develop advanced technology, such as compacting and hauling refuse to remote areas or recycling sewage effluent or finding new uses for many solid wastes.
W71-00829

ENVIRONMENTAL SIMULATION AS A TOOL IN A MARINE WASTE DISPOSAL STUDY OF JAMAICA BAY,
Rand Corp., Santa Monica, Calif.
J. J. Leendertse.
Available from NTIS as AD-703 388, $3.00 in paper copy, $0.95 in microfiche. March 1970. 9 p. P-4163.
Identifiers: *Water pollution, *Estuaries, *Wastes (Sanitary engineering), Simulation, Mathematical models, New York, Fluid flow, Predictions, Transport properties, Models (Simulations), Temperature, *Waste water, Jamaica Bay (New York).

The study of technical solutions to the problem of managing fluid waste discharges in an estuary involves complicated relationships, such as those between the waste load, the location of discharges, the degree of treatment, the geometry of the estuary, the flow in the estuary, and the temperature. Models can be built to predict the probable consequences of each of the alternative solutions chosen. Using the predictions obtained from these models and whatever other information or insight is relevant, alternatives can be compared and conclusions drawn concerning the most desirable course of action. Such a model for well-mixed estuaries and coastal seas is presented and described.
W71-00830

WATER AND SEWERAGE STUDY - FIRST PHASE.
Morris County Planning Board, Morristown, N.J.

Available from NTIS as PB-192 790, $3.00 in paper copy, $0.95 in microfiche. May 1969, 89 p, plates, tabs. HUD P-97.
Identifiers: *Water supplies, New Jersey, *Sanitary engineering, *Sewage, Disposal, Statistical analysis, Rivers, Population, Consumption, Water pollution, *Regional planning and development, *Morris County (New Jersey), *Sewers, Waste water, Waste treatment plants.

The study includes an inventory of existing water and sewerage facilities within Morris County. Analysis of present water consumption and projected population indicates the need for developing additional water supplies on a long-term basis. Future demands of the individual municipalities will exceed the capacity which in many instances can be developed on an individual basis. The low-flow conditions in the streams and the volume of waste water from individual sewage treatment plants, particularly in the Passaic watershed, indicates the need for improved treatment methods in order to meet the stream quality criteria recently established by the New Jersey State Department of Health. Although the average flows in the streams of the County are sufficient to provide adequate dilution for the present volume of waste water discharged, there are times during the summer and fall months when dilution ratios of less than 1 to 1 are available for assimilating the pollutants discharged by the many waste treatment plants located on a stream. A review of available data on the water quality of the stream indicates that the mineral characteristics are such that the waters are suitable as a source of raw water supply with the required degree of treatment dependent upon flow conditions at specific times. Particularly as regards the Passaic watershed, high coliform count and low dissolved oxygen at times preclude the safe use of the majority of the streams for water contact sports such as swimming or the propogation of game fish.
W71-00831

WATER POLLUTION CONTROL CREATES DEMAND FOR GROUNDWATER HYDROLOGISTS,
Geological Survey, Denver, Colo. Water Resources Div.
E. A. Moulder.
Mining Engineering, p 90-91, February 1970. 2 p, 1 fig.

Descriptors: *Water pollution control, *Groundwater, *Water supply, Water pollution sources, Industrial wastes, Mine wastes, Acids, Dewatering, Desalination, Leaching, Chemical analysis, Analytical techniques.
Identifiers: *Groundwater hydrology.

The mining industry is continually faced with problems involving dewatering, pollution, water supply, leaching and hydrochemical mining and prospecting. Greater application of the principles of groundwater hydrology to solution of these problems promises improved operating efficiency, increased safety and better public relations. Estimating the magnitude of dewatering for a proposed

mine may be a major factor in determining the feasibility of proceeding with mine development. Diverting the source of groundwater to an abandoned mine may save costly treatment of acid mine-drainage. Development of a large groundwater supply near an ore deposit may enhance the possibilities of a leaching operation. Detection of certain dissolved minerals in water from springs or wells may lead to hitherto unknown mineral deposits. Current efforts of industry, educational institutions and government are making these kind of events more commonplace. (Woodard-USGS)
W71-00848

SUSQUEHANNA RIVER BASIN STUDY--A PREVIEW.
Susquehanna River Basin Study Coordinating Committee, Baltimore, Md.
For primary bibliographic entry see Field 04A.
W71-00852

OIL AND HAZARDOUS MATERIALS CONTINGENCY PLAN FOR PREVENTION, CONTAINMENT AND CLEANUP FOR THE STATE OF MAINE,
Portland Harbor Pollution Abatement Committee, Maine.
Edward Langlois.
Portland Harbor Pollution Abatement Committee, January 1970. 35 p, 1 map.

Descriptors: *Oily water, *Maine, *Maine pollution control, *Water pollution treatment, Governments, Water law.
Identifiers: Oil spill treatment.

The purpose of this contingency plan is to provide information and recommendations regarding possible oil or other hazardous material spills along the coast or the waterways of Maine to elected and appointed officials and community leaders in municipalities exposed to this danger. This basic information should enable individual municipalities to organize personnel and equipment ot prevent spills and to contain or remove them if a spill does occur. Information is provided to local municipalities regarding the availability of additional help from state and federal agencies. (Knapp-USGS)
W71-00853

RADIOACTIVE WASTE DISCHARGES TO THE ENVIRONMENT FROM NUCLEAR POWER FACILITIES,
Bureau of Radiological Health, Rockville, Md.
For primary bibliographic entry see Field 05B.
W71-00856

ROTARY VIBRATORY FINE SCREENING OF COMBINED SEWER OVERFLOWS,
Cornell, Howland, Hayes and Merryfield, Corvallis, Oreg.
Donald M. Marske.
For sale by the Superintendent of Documents, U S Government Printing Office, Washington, D C, 20402 - $2.50. In: Combined Sewer Overflow Abatement Technology, Water Pollution Control Research Series 11024 - 06/70, p 57-106, June 1970. 50 p, 13 fig, 6 tab, 2 ref.FWQA Contract 14-12-128.

Descriptors: *Storm runoff, *Storm drains, *Sewers, *Overflow, *Water pollution, Chemical analysis, Research, Screens, Model studies, Water pollution control.
Identifiers: *Combined sewer overflows, *Portland (Oreg).

The objective of this study was to determine the feasibility, effectiveness, and economics of employing high-rate, fine-mesh screening for primary treatment of storm water overflow from combined sewer systems. The final form of the screening unit stands 63 inches high and has an outside diameter of 80 inches. The unit is fed by an 8-inch pipe carrying 1700 gpm (122 gal/min/sq ft) which is distributed to a 60-inch diameter rotating (60rpm) stainless steel collar screen having 14 square feet of available screen area and a 165 mesh (105 micron opening, 47.1 percent open area). The screen is backwashed at the rate of 0.235 gallons of backwash water per 1000 gallons of applied sewage. Based on final performance tests run on dry-weather sewage, the unit is capable of 99 percent removal of floatable and settleable solids, 34 percent removal of total suspended solids and 27 percent removal of COD. The screened effluent is typically 92 percent of the influent flow. (See also W70-09558) (Woodard-USGS)
W71-00872

SEWER MONITORING AND REMOTE CONTROL-DETROIT.
Detroit Metro Water Services, Mich.

For sale by the Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $2.50. In: Combined Sewer Overflow Abatement Technology, Water Pollution Control Research Series 11024 - 06/70, p 219-290, June 1970. 72 p, 33 fig, 4 tab, append. FWQA Project 11020 FAX.

Descriptors: *Storm drains, *Sewers, *Overflow, *Water pollution control, Water quality, Monitoring, Remote control, Rain gages, Systems analysis.
Identifiers: *Combined sewer overflows, Storm flow anticipation, First flush interception, Selective retentions, Selective overflowing, Detroit (Mich).

Detroit is faced with the problem of preventing pollution of the Detroit and Rouge Rivers from its combined sewer system overflows. As an alternative to undertaking a dubiously effective sewer separation program, estimated to cost in excess of two billion dollars, the Detroit Metro Water Department has installed the nucleus of a sewer monitoring and remote control 'system' for controlling the pollution from the combined overflow from many small storms at a cost of slightly over two million dollars. The 'system' includes telemetering rain gages, sewer level sensors, overflow detectors, a centrally located computer and data-logger, and a centrally located operating console for controlling pumping stations and selected regulating gates. Installation has been virtually completed and now enables applying such pollution control techniques as 'storm flow anticipation', 'first flush interception', 'selective retention', and 'selective overflowing'. An evaluation of the effectiveness of this initial installation will serve as the basis for determining what additional pollution control facilities are required. (See also W70-09558) (Woodard-USGS)
W71-00876

ORGANIZING FOR SOIL EROSION AND SEDIMENT CONTROL IN OUR NATIONS URBAN AREAS,
National Association of Counties Research Foundation, Washington, D.C.
Mel D. Powell.
For sale by the Superintendent of Documents, U S Government Printing Office, Washington, D C 20402 - Price $2.50. In: Combined Sewer Overflow Abatement Technology, Water Pollution Control Research Series 11024 - 06/70, p 321-336, June 1970. 16 p. FWQA Program 15030 DTL.

Descriptors: *Sediment control, *Erosion control, Urbanization, Road construction, Sewers, Storm drains, Overflow, Storm runoff, Planning, Abatement, Control systems.
Identifiers: *Guide book, *Policy making, Organization for control.

Some considerations involved in organizing an erosion and sediment control program along with some specific organizational structures that may be suitable, with modififfications, to a variety of local situations are discussed. The Federal Water Quality Administration awarded the National Association of Counties Research Foundation a grant to investigate the problem of sedimentation and to develop a guidebook for local policy making officials. Chapter 10 entitled 'Action Guide for Erosion and Sediment Control' from the guidebook published in March 1970 is included in this report. The chapter represents a synthesis of sedimentation control concepts, principles, and techniques, which can be converted into general action plans by local, state, and federal levels of government. (See also W70-09558) (Woodard-USGS)
W71-00877

QUANTITATIVE ANALYSIS OF INDUSTRIAL WATER-USE PATTERNS IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Water Resources Research Inst.
For primary bibliographic entry see Field 06D.
W71-00902

APPROXIMATE HYDRAULIC MODELLING OF STRATIFIED FLOWS IN COOLING PONDS,
A. G. Averkiev, K. Ya. Kind, and I. I. Makarov.
13th Congress of the International Association for Hydraulic Research, August 31-September 5, 1969, Broc. Vol I, Subject A, p 99-103.

Descriptors: Stratified flow, Hydraulic models, *Thermal powerplants, Froude number, Temperature, *Heat balance.
Identifiers: *Cooling Ponds.

An approximate method of modelling and designing the cooling capacity of ponds for thermal power plants taking into account the occurrence of stratified flows in the cooling pond is given. The method is based on experimental findings obtained on large scale hydrothermal models, on field investigation and on scaling of hydrothermal research data to prototype conditions using digital computers. It is shown that heat loss to the atmosphere of thermal jets will be less by two orders of magnitude than the lateral heat transfer. Equations are derived for the case when the warm jet entering a cold reservoir spreads in it causing a two layer motion, the density of each layer being assumed constant across the depth. The heat balance equations for the entire reservoir is solved to define the intake water temperature. The intake cool water temperature for a number of cooling ponds of actual thermal plants was determined by the contours of prototype isotherms and the relations adopted for calculation of heat loss coefficient. Calculation results are in satisfactory agreement with corresponding observed values of the cool water temperature. (Upadhyaya-Vanderbilt)
W71-00918

EFFECTS OF ABATEMENT OF DOMESTIC SEWAGE POLLUTION ON THE BENTHOS, VOLUMES OF ZOOPLANKTON, AND THE FOULING ORGANISMS OF BISCAYNE BAY, FLORIDA,
Miami Univ., Fla. Inst. of Marine and Atmospheric Sciences.
For primary bibliographic entry see Field 05C.
W71-00919

SWINE HOUSING AND WASTE MANAGEMENT - A RESEARCH REVIEW,
National Pork Producers Council; Illinois Univ., Urbana. Coll. of Agriculture.
Arthur J. Muehling.
Department of Agricultural Engineering, College of Agriculture, University of Illinois at Urbana-Champaign, August 1969. 91 p, 232 ref. A. Eng.-873.

Descriptors: *Farm wastes, *Hogs, *Confinement pens, *Aerobic treatment, *Anerobic digestion, Odor, Economics.
Identifiers: *Oxidation ditch, *Housing, Space requirements, Slotted floors, Methods of disposal, Legal implications.

Current and past research in swine housing and waste management is reviewed and summarized. The author utilized 77 references in Part I of the report on swine housing studies. Research on production units, space requirements, slotted floors, and economics of swine housing systems is presented in summary form. Recommendations for future swine housing research are made. 155 references were utilized in Part II of the report on waste management studies. Properties of swine wastes, treatment and return of swine wastes to the land, other methods of disposal, gases and odors, and legal implications of waste handling are summarized. Recommendations for future research in waste management are made. Six fact sheets available from the National Pork Producers Council, Des Moines, supplement the research review. (White-Iowa State)
W71-00924

CONTROL OF HOUSE FLIES IN SWINE-FINISHING UNITS BY IMPROVED METHODS OF WASTE DISPOSAL,
Purdue Univ., Lafayette, Ind. Dept. of Entomology.
R. C. Dobson, and F. W. Kutz.
Journal of Economic Entomology, Vol 63, No 1, February 1970. 6 fig, 3 ref.

Descriptors: *Farm wastes, *Hogs, Disposal, Lagoons, *Insect control, Vectors, Entomology.
Identifiers: *Control of house flies, *Waste disposal systems, Collection pit, Slotted floor.

Four swine-finishing units were equipped with different waste disposal systems to determine their effectiveness in preventing development of the house fly, Musca domestica L. Each unit was completely screened to prevent contamination from outside sources. No insecticides were used. One of the 4 was a standard shed-type house used as a control. The other 3 units were equipped with new and improved waste disposal systems. Results from 2 years of study indicate that house fly production in and around swine-finishing units can be greatly reduced by using 1 of the 3 improved methods of waste disposal described. (Miner-Iowa State)
W71-00932

INFLUENCE OF SPACE ON PERFORMANCE OF FEEDLOT CATTLE,
California Univ., Davis; and Agricultural Research Service, Davis, Calif.
S. R. Morrison, V. E. Mendel, and T. E. Bond.
Transactions of the ASAE, Vol 13, No 1, January 1970, p 145-147. 2 fig, 2 tab, 9 ref.

Descriptors: *Farm wastes, *Cattle, *Performance, *Confinement pens.
Identifiers: *Space, *Influence, *Weight gain, Feed efficiency.

Two tests in the Imperial Valley of California involving 74 heifers indicate that space allotments below 40 sq. ft. per head are likely to reduce the body weight gains and feed efficiency of feedlot cattle, and hot weather may accentuate the decrease. There is evidence suggesting that animal performance may be less even at 40 sq. ft. than at 60 sq. ft. per head. Tests with larger pens and more animals are desirable to establish the relation between gain and feed efficiency and pen space per animal. The range of space tested should be great enough to provide sufficient data to aid in designing feed lots for maximum profit. (White-Iowa State)
W71-00934

WATER POLLUTION CONTROL LEGISLATION,
Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr.
Condensation of report NA68-304 available from ASRE, St. Joseph, Mich. 49085, $0.50. Agricultural Engineering, Vol 50, August 1969, p 468-470. 8 ref.

Descriptors: *Farm wastes, *Water pollution, *Legislation, Water pollution control, Water Quality Act, Biochemical oxygen demand, Phosphates, Effluents.
Identifiers: *Treatment processes, Aerobic oxidation pond, Aerated lagoon, Oxidation ditch, Minimum removal efficiencies, Water quality criteria.

Agricultural production facilities must consider waste disposal as an important aspect of their operations. Waste treatment and disposal facilities are becoming important parts of agricultural production facilities. They must be evaluated whenever expansion or establishment of new facilities is underway. Highly efficient secondary treatment processes perhaps including nutrient removal and disinfection may be necessary for discharging waste waters to surface waters. The need for and cost of these processes should cause a re-evaluation of the comparative costs of handling, treatment, and disposal of agricultural wastes as a solid. Land disposal is another alternative. When agricultural wastes are handled to avoid polluting surface waters, other types of pollution must be avoided. Mere transferral of pollution from one sphere to another will no longer be tolerated. These are among the aspects which this paper deals with. (White-Iowa State)
W71-00935

CATTLE FEEDERS AVOID POLLUTION BY USING WASTES IN IRRIGATION.
Soil Conservation Service, Washington, D.C.

Soil Conservation, Vol 34, No 4, November 1968, p 84-86. 3 fig.

Descriptors: *Farm wastes, *Cattle, *Ponds, *Furrow irrigation, Lagoon, Water pollution, Nebraska, Water Quality Act, Costs, Loess.
Identifiers: *Tractor driven pump, Soil Conservation Service, Feedlots.

Two brothers in Franklin county Nebraska have implemented a system that avoids pollution while fertilizing and irrigating their land. Solid wastes are hauled to the field from their 5 feedlots covering four acres. The rest washes down with every rain and is caught in a farm pond in a natural draw. In the bottom of the pond a lagoon-type pit was dug so there will always be some water available to keep wastes in suspension. From here the suspension is pumped to nearby fields by a tractor driven pump. If it doesn't rain they pump water from their irrigation wall into the pond and out again onto the land. (White-Iowa State)
W71-00939

IRRIGATING WITH ANIMAL WASTE,
Soil Conservation Service, Hermiston, Oreg.
Clarence Underwood.
Soil Conservation, Vol 34, No 4, November 1968, p 81-82. 3 fig.

Descriptors: *Farm wastes, *Hogs, *Irrigation, *Sewage disposal, Effluent, Soil conservation, Odor, Fertilization, Lagoons, Sprinkler irrigation, Nitrogen, Waste dilution, Water pollution.
Identifiers: *Soil Conservation Service, Velocity-controlled water outlets, Holding basin.

Two brothers purchased a civilian housing facility from the Umatilla Army Depot and converted the 57 units to hog production. Wastes from the 22,000 hog per year facility are flushed into a gutter, through a sewer system and into the first of two lagoons. A second holding basin allows additional settlement and dilution of solids. From here it is pumped to irrigate about 500 acres of land. The brothers estimate that their system puts about 5 pounds of nitrogen per acre on a field each time it is irrigated. The crops are fertilized, little odor is noticeable, and no water pollution has been detected. (White-Iowa State)
W71-00941

COST ANALYSIS OF IMPROVED REGULATION OF THE COLUMBIA RIVER TO INCREASE MINIMUM FLOW IN THE HANFORD PLANT VICINITY,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
For primary bibliographic entry see Field 06A.
W71-00975

NANCE V MERCHANTS' FERTILIZER PHOSPHATE CO (LIABILITY FOR NEGLIGENCE IN POLLUTING A STREAM).
For primary bibliographic entry see Field 06E.
W71-01005

MOODY V BURRELL (REMEDY FOR POLLUTION OF WATER SUPPLY BY DOMESTIC SEWAGE SYSTEM).
For primary bibliographic entry see Field 06E.
W71-01023

DONNELLY BRICK CO V CITY OF NEW BRITAIN (POLLUTION OF RIPARIAN WATERS).
For primary bibliographic entry see Field 06E.
W71-01042

MASONITE CORP V BURNHAM (LIABILITY FOR WATER POLLUTION).
For primary bibliographic entry see Field 06E.
W71-01046

VILLAGE OF WOODBRIDGE V BOGAN (EMINENT DOMAIN AND LIABILITY FOR DAMAGES DUE TO WATER POLLUTION).
For primary bibliographic entry see Field 06E.
W71-01055

EASTON V STATE (AMOUNT OF COMPENSATION FOR TAKING OF LAND AND POLLUTING A STREAM).
For primary bibliographic entry see Field 06E.
W71-01073

SOUTHERN NEW ENGLAND ICE CO V TOWN OF WEST HARTFORD (CITY LIABLE FOR NUISANCE CAUSED BY DUMPING SEWAGE INTO STREAM).
For primary bibliographic entry see Field 06E.
W71-01074

OLD DOMINION LAND CO V WARWICK COUNTY (COUNTY HAS LIMITED POWER TO PROHIBIT POLLUTION IN NAVIGABLE RIVER.
For primary bibliographic entry see Field 06E.
W71-01077

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

URBAN WATER POLICIES IN THE DETROIT METROPOLITAN REGION,
Michigan Univ., Ann Arbor. Office of Research Administration.
George M. Walker, Jr., and Norman Wengert.
Available from NTIS as PB-195 313, $3.00 in paper copy, $0.95 in microfiche. Final Report, July 1970. 271 p, 4 map, 8 tab, 1 chart, 166 ref, 10 append. ORA Project 01351. OWRR Project C-1142 (No. 1589).

Descriptors: *Water policy, *Decision-making, Interagency co-operation, Political aspects, Urbanization, City-planning, Municipal water, Administrative decisions, Water districts, Treatment facilities.

Identifiers: *Metropolitan areas, Public policy, Water resource planning, Political equity, Comprehensive planning, Water supply systems.

The report deals with the period after 1959 when the Detroit Water Board took action to become the water supply agency for the entire metropolitan area. The most critical issues of regional water service lie in the area of inter-governmental relations because of the Board's necessity of selling water at wholesale prices to suburban governments. Basic propositions concerning the Detroit sjtuation are: (1) For efficiency in distribution costs and equity for consumers a unified water supply system is best; (2) Physical water supply is not a problem in the Detroit region; (3) Engineering problems of supplying water are minimal because of level terrain; (4) Major problems are political and institutional; (5) Economic problems are not overwhelming; (6) Water policy decisions are dispersed throughout the system; (7) Decisions affecting water policy may be influenced by other problems of dispersed power in the metropolitan area. (Wray-Chicago)
W71-00706

COMPUTERS IN THE RESEARCH AND TEACHING OF HYDROLOGY,
Environmental Dynamics, Inc., Los Angeles, Calif.
Venkateswararao Vemuri.
Progress of Hydrology, Vol 1, p 290-315, July 1969. 26 p, 1 fig, 9 ref.

Descriptors: *Hydrology, *Systems analysis, *Analog computers, *Digital computers, Simulation analysis, Monte Carlo Method.
Identifiers: Hybrid computers, Signal processing, DSCT, CSDT, DSDT.

This paper systematically explored trends of research in simulation and signal processing as they apply to hydrology and how modern computational tools shape the course of events and thinking at educational and research institutes attempting to solve these problems. It was said that hydrology can be divided into two classes: (1) the scientific or technological aspects of the problem and (2) the management or behavioral aspects of the problem. A narrative description of hydrological systems was given. Two distinct formats in problem specification, direct and inverse, were presented in detail. Computational demands in hydrological systems analysis included signal processing problems and simulation problems. The conventional computational tools, which serve the needs of simulation, mentioned were analog computers, digital computers and passive network analogs. The hybrid computer which attempts to take advantage of the attractive features of both analog and digital computers was described. A comparison of the discrete-space and continuous-time (DSCT) technique and the continuous space, discrete-time (CSDT) method as a means of solving a problem numerically was given. A third method of solving was the discrete-space, discrete time (DSDT) method which has been used to identify the transmissibility storage coefficient and boundary of an aquifer. An alternate method mentioned was the Monte Carlo Method. (Kriss-Cornell)
W71-00708

STREAMFLOW SYNTHESIS FOR UNGAGED RIVER,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 02E.
W71-00709

FUNCTIONAL EVALUATION OF A WATER RESOURCES SYSTEM,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Leo R. Beard.
Tech Paper No 4, The Hydrologic Engineering Center, Corps of Engineers, US Army, Jan 1967. 18 p, 2 fig, 6 tab.

Descriptors: *Computer programs, *Systems analysis, *Hydrologic aspects, *Water resources development, *Reservoir operation, *Simulation analysis, Conservation, Optimization, Costs.
Identifiers: Willamette River Basin, Susquehanna River Basin.

A generalized computer program for evaluating the conservation accomplishments of an extremely complex water resources system developed in the Hydrologic Engineering Center of the Corps of Engineers, US Army was described. The program, 'Reservoir Systems Analysis-Conservation', has been used in preliminary studies to evaluate the functional (hydrologic) accomplishments of large water resource systems in the Susquehanna and Willamette River Basins and of several smaller systems. This elaborate computer program simulated the operation of a water resources system for many conservation functions such as water supply, power generation and low-flood regulation, recognizing the important constraints imposed by flood control requirements. It simulated the operation usually on a month-by-month basis with provision for operation by any regular or irregular intervals. The manner in which the water resources system was described to the computer was illustrated by use of an example for the Willamette River Basin study which considered 27 control points, 13 diversions and 14 reservoirs with 5 power plants. The program was designed for simplicity of use and costs per operation study with a high-speed computer are nominal. (Kriss-Cornell)
W71-00710

METHOD FOR DETERMINATION OF SAFE YIELD AND COMPENSATION WATER FROM STORAGE RESERVOIRS,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 04A.
W71-00711

A HYDROLOGIC WATER RESOURCE SYSTEM MODELING TECHNIQUE,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 04A.
W71-00712

WORTH OF STREAMFLOW DATA FOR PROJECT DESIGN - A PILOT STUDY,
Geological Survey, Sacramento, Calif. Hydrologic Systems Lab.; and Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 04A.
W71-00714

SIMULATION OF DAILY STREAMFLOW,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 02E.
W71-00715

HYDROSTATISTICS - PRINCIPLES OF APPLICATION,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Leo R. Beard.
Tech Paper No 15, The Hydrologic Engineering Center, US Army Corps of Engineers, July 1969. 11 p, 41 ref.

Descriptors: *Hydrologic properties, *Statistical methods, *Decision making, *Design criteria, *Probability, Time.
Identifiers: *Hydrostatistics.

The purpose of this paper was to discuss briefly and very generally the nature of hydrologic engineering problems that could be solved through application of statistics and to examine the basic concepts involved in the application of statistics to such problems. The importance of applying statistics to a complete decision process, rather than to an incompletely separable link of that process, was emphasized. Hydro-statistics which have historically been concerned primarily with the determination of the probability or frequency of events and the correlation or interrelation among events, were discussed. It was said that in most cases of hydrologic design, it is traditional to select a design criterion that expresses the adequacy in terms of probability of exceedence. An example of a water supply reservoir that might be designed for a drought that would be exceeded once in 25 years was given. Discussions were based upon the objective of determining expectation over a long period of operation of a specific project design, rather than evaluation of the probability of hydrologic events independent of any design. These included probability of a single event, indirect probability determinations, coincident probability determinations and complex probability problems. Has 41 references. (Kriss-Cornell)
W71-00719

THE MATHEMATICAL SIMULATION OF THE HYDROLOGY OF SMALL WATERSHEDS,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02E.
W71-00720

OPTIMUM GAGING STATION LOCATION,
Geological Survey, Washington, D C.
Nicholas C. Matalas.
Progress of Hydrology, Vol 1, p 473-489, July 1969. 17 p, 6 ref.

Descriptors: *Optimization, *Regression analysis, *Regional analysis, *Flow characteristics, *Gaging stations, Budgeting, Cost.

For an existing network of stations, two approaches were presented for determining an optimal scheme of gaging. Both approaches utilized the correlation between flow sequence to establish a regression relation, whereby, the flow properties of a discontinued station may be inferred from the properties of stations that are not discounted. The first approach sought to identify those stations that were to be discontinued, such that the sum of the variances of the estimates of a flow property at all stations was a minimum subject to a budgetary constraint. Minimizing the sum variances was equivalent to maximizing the total information content. The second approach considered the networks of stations for several regions and sought to identify those stations within the region that may be discontinued, such that the unit cost of information was the same for all regions. This approach was combined with a regional analysis of the information at the stations in an existing network to provide a basis for selecting among many ungaged sites those that are to be gaged. A regression analysis that relates a flow property at each station to a physiograph and metorologic characteristics associated with each station was used. The approaches for both gaged and ungaged sites were illustrated in terms of only one flow property-the mean for a sequence of flow observations. The approaches were quite general and could be applied to many flow properties. (Kriss-Cornell)
W71-00721

MATHEMATICAL METHODOLOGY IN HYDROLOGY,
Arizona Univ., Tucson. Hydrology and Water Resources.
Chester C. Kisiel.
Progress of Hydrology, Vol I, p 362-399, July 1969. 38 p, 3 fig, 1 tab, 71 ref.

Descriptors: *Mathematical modeling, *Hydrology, *Probability, *Systems analysis, *Research and development, *History.
Identifiers: Hydrologic problems.

The purpose of the paper was: (a) to review the current state of the art, both in practice and research, in the use of mathematical methods in hydrology, and (b) to suggest directions for more efficient integration of mathematics into hydrologic education and research. Two dichotomous views in hydrology as contrasted with the philosophy of modern science were identified. The dichotomies were: (a) between the empirical and scientific approaches, and (b) between the deterministic and probabilistic approaches to modeling. In addition, discrete models used in hydrology were contrasted with continuum models. Two types of problems associated with hydrologic systems were described as either direct (forward) or inverse. Direct problems were said to be in the classical tradition and the system was known prior to characterization in terms of a mathematical equation. Classes of inverse problems mentioned include: control, identification, and estimation. Complete summaries of these and other problems were given and included error analysis and problem solving. Current teaching and research in the field of hydrology received comment. Has 71 references. (Kriss-Cornell)
W71-00722

THE ROLE AND DEVELOPMENT OF THE PROGRAMMING LANGUAGE 'HYDRO' IN HYDROLOGY,
Carnegie-Mellon Univ., Pittsburgh, Pa.
George Bugliarello.
Progress of Hydrology, Vol I, p 233-264, July 1969. 32 p, 13 fig, 16 ref.

Descriptors: *Hydrology, *Computer programs, *Programming languages, *History, *Design criteria, *Operations, *Analytical techniques, Water resources development, Engineering.

Summarized were the programming needs in hydrology to which HYDRO, a flexible computer language for water resource engineering, was intended to respond a review of the history, the specifications and design criteria of HYDRO, and a description of the operation of different components of HYDRO systems were presented. The organizations performing broad hydrological work were classified into six categories, according to size of the hydrologic cycle segment with which they are usually most concerned, and also according to their degree of specialization. Three pivotal programming needs in hydrology were considered. The HYDRO system dates back to 1961 and a complete history including design philosophy and specification was given. The five main areas included in the HYDRO library procedures of direct relevance to hydrology, were: frequency analysis, precipitation analysis, hydrograph analysis, open-channel hydraulics, and flood routing. The HYDRO syntax for hydrograph analysis was shown. The writing and operation of HYDRO programs was explained and examples were given. Described were the combination of the features of HYDRO and the universal algebraic computer language ALGOL into a single language HYDRALGOL and other extensions, was said to be an effective tool in the solution of selected problems and in accelerating the training of personnel in the area of hydrologic analyses. (Kriss-Cornell)
W71-00723

MATHEMATICAL MODELING IN HYDROLOGY,
Geological Survey, Menlo Park, Calif.
D. R. Dawdy.
Progress of Hydrology, Vol I, p 346-361, July 1969. 16 p, 91 ref.

Descriptors: *Mathematical models, *Optimization, *Hydrology, *Stochastic processes, *Simulation analysis, *Systems analysis.

This paper described the areas of interest of the working groups under the Committee on Mathematical Models in Hydrology established by the International Association of Scientific Hydrology in October 1967. The three named working groups were: Parametric Hydrology, Stochastic Hydrology and Water Resources Systems and stressed the applications of particular mathematical tools rather than stressing the discipline in which a particular problem occurs. First the purpose of simulation models and types of simulation models were given. Parametric modeling of surface runoff was then shown to be divided into component modeling and integrated system modeling. A section on stochastic modeling gave methods of stochastic simulation and their uses. Mathematical programming, use of stochastic models in systems analysis and other systems analysis techniques were described as part of mathematical modeling of water resources systems based upon the optimization of some goal, subject to constraints imposed upon the system. (Kriss-Cornell)
W71-00724

DETERMINISTIC NONLINEAR HYDROLOGIC MODELS,
Geological Survey, Washington, D.C.
J. Amorocho.
Progress of Hydrology, Vol 1, p 420-472, July 1969. 53 p, 12 fig, 37 ref.

Descriptors: *Hydrology, *Mathematical models, *Optimization, *Water storage, Operations.
Identifiers: *Determinism, *Non-linear models, Functional model, Conceptual model.

The impossibility of formulating any real hydrological situation in strictly deterministic terms because of the problems of time variability, input, output and systems uncertainties, and system representation was discussed. The various types of deterministic models in hydrology were described and examples of their use were given. First, operational representation was described where 'operators' contained in the equations perform mathematical operations on a set of variable to produce a function of these variables. An operational representation of a simple storage system was an example. Functional representation described another way of representing a system. A third major category of deterministic models comprised structures in which a schematization of the hydrologic unit is performed. The name 'conceptual model' was given to this idealized process. The flow diagram of a model which attempted to synthesize the operation of a natural system, termed 'hydrologic systhesis,' was shown. The fact that most methods of the deterministic approach are still in an exploratory stage was summarized. (Kriss-Cornell)
W71-00726

SYSTEMS APPROACHES IN HYDROLOGY AND WATER RESOURCES,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ven Te Chow.
Progress of Hydrology, Vol I, p 490-509, July 1969. 20 p, 4 fig, 9 ref.

Descriptors: *Hydrology, *Stochastic processes, *Systems analysis, *Water resources development, Mathematical models, Simulation analysis, Economics, Education.

The objective of this paper was to recapitulate current thinking on hydrologic systems, to describe stochastic hydrologic systems, and to discuss hydrologic systems and hydro-economic systems in water resources planning and development. Various parts of the hydrologic system were said to be interception, evaporation, transpiration, infiltration detention, retention, surface runoff, subsurface runoff and groundwater flow, and were considered as hydrologic subsystems. An open-loop system and a closed-loop system were described. Mathematical simulation of natural hydrologic systems achieved by means of either a lumped-system model or a distributed-system model was discussed. Comparisons of non-linear and linear systems, time variant and time-invariant and deterministic and probabilistic were made. Questions posed on the mathematical simulation of the hydrologic system of watersheds at the International Hydrology Symposium in 1967 were restated with some modification. A comparison of the conventional approach and the stochastic approach in hydrologic systems analysis was illustrated. A view of the system approach as part of the hydroeconomic system for water resources planning and development was shown through an outline of the educational programs in water resources engineering followed by many universities. (Kriss-Cornell)
W71-00727

DETERMINISTIC LINEAR HYDROLOGIC SYSTEMS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
Peter S. Eagleson.
Progress of Hydrology, Vol I, p 400-419, July 1969. 20 p, 38 ref.

Descriptors: *Linear programming, *Mathematical models, *Optimization, *Groundwater movement, Surface runoff, Reservoirs, Hydraulic systems.
Identifiers: Determinism, Identification problems.

This paper attempted to answer the question of why hydrologists devote so much time to linear deterministic methods in a non-linear stochastic real world. A reply was given with respect to determinism and with respect to linearity. Mathematical representation of linear systems was described using differential equations and integral equations. The approach to finding the kernel of a linear hydrologic system through the solution to the linearized differential equation which best represents the phenomenon of interest was proposed. Surface runoff, infiltration and capillory use, and groundwater motions were considered. A second approach to finding the kernel of a linear hydrologic system was through a synthesis of system behavior in terms of one or more lumped elements which reproduce, in linear form, the primary hydraulic operations such as storage and translation of concern to the phenomenon being modelled. Linear reservoirs, linear channels, combined linear elements and conceptual linearization were considered. The problem of determining the system kernel, or 'the identification problem,' was discussed. Identification of either truly linear or optimally linear systems was distinguished. 'Black box' methods or 'parametric' methods were regarded as further subdivisions of the identification problem. A review of techniques for finding linear kernels given observations of system input and output was given. (Kriss-Cornell)
W71-00728

THE COMPUTER AND HYDROLOGY,
California Univ., Riverside. Dry-Lands Research Inst.
Warren A. Hall.
Progress of Hydrology, Vol I, p 226-232, July 1969. 7 p.

Descriptors: *Computers, *Hydrology, *Parametric hydrology, *Stochastic processes, Statistical methods, Mathematical models.

A brief review of the trends toward mathematical sophistication in hydrology was presented in order to put in proper perspective some ideas of the role of computers in the future of hydrology. Included were: the parametric approach, i.e., the identification of a set of parameters which described the 'state' of the watershed and the functions by which state determines the response to the input precipitation function; and the stochastic approach which used direct statistical analysis to estimate the average return period between floods at any given magnitude. Both of these procedures have received a major impetus with the advent of the computer. Some of the shortcomings of the present computer-based developments in hydrology were discussed. It was felt that the most urgent concern was for the application of systems identification and similar analytical techniques to develop physically based

and physically describable models of the principal interactive hydrological processes. (Kriss-Cornell)
W71-00729

A MODEL OF OPTIMUM WATER ALLOCATION UNDER IOWA'S PERMIT SYSTEM,
Iowa State Univ., Ames.
R. A. Baldwin.
Thesis, Master of Science, Iowa State, 1970. 147 p, 3 fig, 27 tab, 2 append, 107 ref. OWRR Research Report No. B-009-1A (1).

Descriptors: *Optimization, *Linear programming, *Water allocation (Policy), *Model studies, *Systems analysis, Hydrologic aspects, Economics.
Identifiers: Iowa's water permit system.

The three objectives of this study were: (1) to analyze Iowa's water permit system, constructing an estimate of the system's allocation in times of water scarcity; (2) to construct a model which will yield in specific situations both an optimum water use pattern and values for water in its various uses; (3) to apply the model developed in objective two and the estimate constructed in objective one to a specific situation. Three procedure phases were described. The first phase was examined as a physical and as a economic entity and then the necessary and sufficient conditions for optimum resource allocation were derived. The second analytical phase examined origins and general characteristics of allocative mechanisms currently in use in the United States. A specific hypothesis based on Iowa's permit system was developed and a general model which utilized linear programming to describe the interaction between hydrologic and economic systems, generating approximate values for water optimally allocated among various uses, was developed. The third phase of the study was empirical and consisted of application of the linear programming model to two water use situations, one real, the other hypothetical. A description of the results of the applications was given. Recommendations for further research were suggested. (Kriss-Cornell)
W71-00730

USE OF ANALOG COMPUTER IN GROUNDWATER HYDROLOGY,
Minnesota Univ., Minneapolis. Water Resources Research Center.
For primary bibliographic entry see Field 04B.
W71-00732

THE PROGRESS OF HYDROLOGY.

New Developments in Hydrology, IHD and UNESCO, Vol I, 1969. Proceedings First International Seminar for Hydrology Professors, July 13-25, 1969, Univ. of Illinois, Urbana, 509 p, numerous fig, tab, append. NSF Advanced Science Seminar.

Descriptors: *Hydrology, *Hydrologic education.

As a first step to meet the need for a more progressive hydrologic education in government as well as in scientific committees, an International Seminar for Hydrology Professors was held from July 13 to 25, 1969, in Urbana, Illinois on the Urbana-Champaign Campus of the University of Illinois. The seminar was aimed at an advanced level of discussion and exploration in hydrologic education. A total of 62 papers were presented and preprinted for distribution at the seminar. Of these papers, 20 were on new developments in hydrology, 19 on specialized subjects in hydrology, 10 on hydrologic education and 13 on various country reports. All submitted papers and discussions were included in the Proceedings under four main headings: new developments in hydrology, specialized subjects in hydrology, hydrologic education, and discussions. Specific objectives of the seminar included discussions on new developments in stochastic analysis, and systems simulation and model formulation and to provide discussion of teaching and research methods, techniques, and instrumentation including facilities for hydrologic laboratories and teaching aides. (Kriss-Cornell)
W71-00733

INVESTMENT ANALYSIS UNDER UNCERTAINTY
Stanford Univ., Calif. Graduate School of Business.
Robert Wilson.
Management Science: Application, Vol 15, No 12, Aug 1969, pp B650-664. 15 p, 2 fig, 11 ref, 1 append.

Descriptors: Investment, Analysis, Interest, Mathematical models, Time, Project planning, Diversification, Risks, Optimization, Design.
Identifiers: Event tree, Smoothing effect.

Investment projects were described as a pattern of uncertain cash flows over time; i.e., as a cash flow pattern over an event tree. Sufficient conditions for accepting and rejecting individual projects were formulated as mathematical programming problems which were amendable to routine application at subordinate levels of an organization. The time dimension of a state description was made explicit by constructing the 'event tree' specifying the sequence of states that it can obtain. An example of the event tree over four time periods was given where the number of possible states was finite, each state had only one successor node, and each node had only one predecessor arc. An abbreviated project description was used for the purpose of analysis of the state-relevant description of investment projects. The methodology of investment analysis under uncertainty was described where two characteristic rationale were used: 'smoothing' effect and 'diversification' effect. Examples were given. The sufficient conditions for inclusion of projects and exclusion of projects and the systematic analysis of these solutions were investigated. Finally, a mathematical programming formulation was developed which embodied measures of risk aversion and intertemporal income preferences. The optimal design of a complementary financing program for a project yielded inclusion criteria for its acceptance, and analysis of the borderline case between risk aversion and risk preference yielded an exclusion criterion. This paper has relevance to water resources investments having uncertain future returns. (Kriss-Cornell)
W71-00734

SOME ASPECTS OF EDUCATION AND RESEARCH IN STOCHASTIC HYDROLOGY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Vujica Yevjevich.
The Progress of Hydrology, Vol I, pp 316-333, July 1969. 24p.

Descriptors: *Stochastic processes, *Hydrology, Mathematical modes, *Statistical methods, *Digital computers, *Hydrologic data, Engineering, Data collection.
Identifiers: Time-space trade.

Some crucial subjects considered as being significant for education, researchand practical developments in hydrology for the next decade were presented. First three types of hydrologic processes: deterministic, stochastic and combined deterministic-stochastic were described. The roles of probability theory, mathematical statistics and stochastic processes in hydrology and water resources were catagorized into three types and can be applied in advancement in research and education. Discussed was the use of computers in hydrology especially the digital computer which has made many hydrologic equations, methods and procedures of pre-computer age absolete. The problem of hydrologic data scarcity and the application of statistics was also discussed. Two basic and opposite approaches used in design of a hydrologic observation system mentioned: were a) hydrologic approach, which includes climatologic, hydrogeologic, general geophysical and similar points of view; and b) engineering approach, which is dominated by civil, hydraulic or sanitary engineering points of view. Other topics included were: transfer of hydrologic information from point to point, transfer of information from one hydrologic variable to another, risk and uncertainty in hydrologic information, procedures for extracting the most information from a given hydrologic amount of data and effect of additional short-term observations on total information. A time-space trade concept was explained which is a promising approach for regions with crucial scarcity of data. (Kriss-Cornell)
W71-00735

PRODUCTION AND INVESTMENT IN NATURAL RESOURCE INDUSTRIES,
Montana State Univ., Bozeman; and Resources for the Future, Inc., Washington, D.C.
Oscar R. Burt, and Ronald G. Cummings.
American Economic Review Vol LX, No 4, p 576-590, September 1970.

Descriptors: *Optimization, Depreciation, Discount rate.
Identifiers: *Social benefit function, User-cost, Lagrangian expression, Opportunity cost.

The authors develop a general model for social production and investment in natural resource industries which can be adapted to any specific resource. The social benefit function is formulated subject to constraints and the Lagrange method used for a solution. The optimum time paths for production and investment are generated by the model while assuming society's planning horizon is finite. The decision rule for the optimum time path of resource use is to increase production until net marginal social benefits equal user costs (as defined in the model). The optimum time path for social investment occurs when the marginal social cost of investment in the current period is equal to the discounted value of the increment to all future capital stocks associated with an increment to current investment. The model is generalized to include multiple interrelated resources and capital stocks and infinite planning horizon. This model is of interest to water studies concerned with planning the development of water resource sites. (Siegenthaler-Rutgers)
W71-00751

COMMENTS ON TIME-CAPACITY EXPANSION OF URBAN WATER SYSTEMS,
Cornell Univ., Ithaca, N.Y.
Marshall Gysi.
Water Resources Research Vol 6, No 3, p 993-995, June 1970.

Descriptors: *Water supply, *Mathematical models, *Demand, *Forecasting, Economic evaluation, Prices, Cost minimization, Maximization, Optimization, Economies of scale, Water shortage, Dynamic programming, Benefits.
Identifiers: *Community surplus, *Over-demand, Derived demand.

The author elaborates on a method previously developed by Russell Scarto for estimating a more economically efficient capacity expansion schedule for a municipal water supply utility. He points out that recent studies on consumer demand relationships for water provide information that should be included in mathematical models which have as their object the maximization of the net present value of future community economic surpluses. In planning for system capacity a less than infinite penalty cost should be included for optimum welfare. The author outlines how losses due to overdemand can be estimated from the consumer's demand function. He presents a dynamic programming approach for the estimation of the expansion path of the water supply facilities which maximizes the present value of future marginal net benefits to the community. The article concludes with a statement of the importance of further research in the area of water pricing and consumer demand. (Murphy-Rutgers)

W71-00757

PRICE DISTORTION AND ECONOMIC WELFARE,
Minnesota Univ., Minneapolis; and Pennsylvania State Univ., University Park.
Edward Foster, and Hugo Sonnenschein.
Econometrica, Vol 38, No 2, p 281-297, March 1970.

Descriptors: *Welfare economics, *Model studies, *Economic evaluation, *Mathematical studies, *Taxes, Prices, Optimization, Social aspects, Government, Government supports, Budgets, Equilibrium, Costs.
Identifiers: *Subsidies, *Marginal rate of transformation, *Marginal rate of substitution, Utility, Economic distortion.

This paper presents an economic model in which equilibrium positions are characterized by specified inequalities between society's marginal rates of transformation in production and consumers' marginal rates of substitution in consumption. This condition is often present in water resource development projects due to the presence of externalities in both the consumption and production of a water supply system. The authors use the device of certain mapping defined on the set of efficient production in order to investigate the effect on welfare from changes in the inequalitites. The paper proceeds to derive the mathematical restrictions which these mappings must satisfy in order to yield positive results and to specify what conditions are necessary for these restrictions to hold. The analysis leads to the conclusion that a radical decrease in a specific economic distortion will improve welfare. (Murphy-Rutgers)
W71-00766

OPTIMALITY, 'PUBLIC' GOODS, AND LOCAL GOVERNMENTS: A GENERAL THEORETICAL ANALYSIS,
Northwestern Univ., Evanston, Ill.
Mark V. Pauly.
Journal of Political Economy, Vol 78, No 3, p 572-585, May/June 1970.

Descriptors: *Optimization, Marginal utility, Marginal costs, Migration.
Identifiers: *Public goods, Net benefits, Pareto optimal, Edgeworth box, Neighborhood effects.

This paper attempts to reconcile divergent analyses with respect ot the Pareto optimality conditions in the provision of a public good by politically separate local governments. The confusion has occurred because of the failure of researchers to specify in what way the local public good being considered has elements of publicness. To clarify matters, four cases of goods within and between communities are considered: (1) purely private, (2) purely public, (3) purely public good within but private between, (4) impurely public within but private between communities. In each case, the pure public good in the Samuelson sense is identified and equilibrium and optimality conditions for that good are specified. The actual element of publicness for each case is analyzed and the deviation from the optimum is shown for local government actions. Special attention in case four is given to the problem of education and migration, and the author shows some departures from the optimum. This analysis is of relevance to water managers concerned with the welfare implications of water resource development. (Siegenthaler-Rutgers)
W71-00770

A NOTE ON ENGINEERING EMPIRICISM AND ECONOMIC THEORY,
Oak Ridge National Lab., Tenn.
Duane Chapman.
Engineering Economist Vol 15, No 4, p 243-248, Summer 1970.

Descriptors: *Cost minimization, *Mathematical studies, *Optimization, *Economic evaluation, Prices, Engineering, Estimated costs, Cost analysis.
Identifiers: *Homogeneous production function, Lagrangian optimization, *Scale factor.

The author explores the linkage between the economic concepts of the homogeneous production function and Lagrangian optimization and the use, in engineering cost estimates, of a scale factor in cost extrapolation. A common example of a scale-factor equation in engineering design is given. This equation can be derived by minimizing the cost of production for any fixed output point for a homogeneous production function. The author concludes from this analysis that the homogeneous production function and the scale-factor cost equation may be representations of some underlying physical reality. Since engineering and economic concepts are both used in water resource cost analysis this article explains the relationships between these familiar techniques and concepts. (Murphy-Rutgers)
W71-00771

OPTIMAL DEPARTURES FROM MARGINAL COST PRICING,
Princeton Univ., N.J.
William S. Baumol, and David F. Bradford.
American Economic Review Vol LX, 1103, p 265-283, June 1970.

Descriptors: *Welfare economics, *Prices, *Marginal cost, *Taxes, *Optimization, Resource allocation, Mathematical study, Government, Demand, Equilibrium, Social aspects, Elasticity of demand, Profits, Costs.
Identifiers: *General equilibrium, *Second-best, Price elasticity, Excise tax, Income tax, Pareto optimality.

The authors are concerned with those situations where deviations from marginal cost pricing are necessary for optimal resource allocation. This condition has particular relevance for utility pricing and should make the article of interest to pricing policy studies in water utilities. Due to the effects of taxes, the problem is in the area of second best and the solution arises from the theory of taxation and the analysis of public utility regulation. The paper describes the rules indicating whether a particular price-output combination which satisfies the profit constraint is socially optimal. The authors discuss four variants of the usual welfare optimization theorem, each of which gives a set of necessary conditions for quasi-optimal pricing. A simple general equilibrium model is then presented and the effect of taxes on different sectors of the economy explained. The authors conclude their analysis with an outline of the past literature of this problem. (Murphy-Rutgers)
W71-00773

TWO METHODS OF COMPUTING FULL-INFORMATION MAXIMUM LIKELIHOOD ESTIMATES IN SIMULTANEOUS STOCHASTIC EQUATIONS,
IBM Watson Research Center, Yorktown Heights, N.Y.
Gregory C. Chow.
International Economic Review Vol 9, No 1, p 100-112, February 1968.

Descriptors: *Mathematical studies, *Statistics, *Economic evaluation, *Maximization, Least-squares method, Regression analysis, Probability.
Identifiers: *FIML, *Iterative method, Nornal equations, Limited information, Convergence.

This paper attempts to derive an explicit set of equations for full-information maximum likelihood estimates of parameters in a system of simultaneous linear stochastic equations. It also presents two iterative methods of solving these equations. Assuming, all structural equations to be stochastic, a set of normal equations is derived. The author discusses the treatment of identities and linear restrictions on coefficients and gives a numerical example. This article is relevant to the water researcher interested in the use of simultaneous equation systems for estimating water models. (Murphy-Rutgers)
W71-00774

SOME EFFECTS OF INCORRECT SPECIFICATION ON THE SMALL-SAMPLE PROPERTIES OF SEVERAL SIMULTANEOUS-EQUATION ESTIMATORS,
British Columbia Univ., Vancouver.
John C. Cragg.
International Economic Review Vol 9, No 1, p 63-86, February 1968.

Descriptors: *Mathematical studies, *Economic evaluation, *Model studies, *Statistics, Sampling, Least squares method, Regression analysis, Probability.
Identifiers: *Misspecification, Ordinary least squares, Two-stage least squares, Estimators.

This paper provides some sampling experiment results exploring the effects of certain misspecifications on several simultaneous equation estimators. The main type of misspecification investigated is the incorrect exclusion of variables from certain equations or the model itself. Experiments are reported where important non-zero coefficients were specified to zero in the structure estimated and there is a discussion of the effects of the specification of small coefficients to be zero in order to obtain identification. The omission of an exogenous variable from the estimated structure is considered along with the related aspect of omitting an equation. The last problem discussed is that of the effects of failing to specify as zero all the structural coefficients for which such a specification would be valid. The general conclusion of the author, is that the different failures of specification investigated may have serious effects and he suggests a difficult task, in econometric model-building, of steering between misspecification and underspecification. This paper is relevant for the choice of variables in econometric studies of water resources. (Murphy-Rutgers)
W71-00775

NONLINEAR SIMULTANEOUS EQUATIONS: ESTIMATION AND PREDICTION,
Princeton Univ., N.J.
Stephen M. Goldfeld, and Richard E. Quandt.
International Economic Review Vol 9, No 1, p 113-136, February 1968.

Descriptors: *Mathematical studies, *Statistics, *Forecasting, *Regression analysis, Sampling, Model studies, Computers, Maximization.
Identifiers: *Two stage least squares, *Direct least squares, *FIML, *Nonlinearities.

This paper analyzes the small-sample properties of the parameter estimates of two specific nonlinear systems. The authors present two models on which they conducted experiments consisting of generating normally distributed error terms, solving the structural equations for the values of the endogenous variables and using the resulting data series to estimate the coefficients of the equations with several techniques. The estimating methods used were; direct least squares, (DLS), full-information maximum likelihood (FIML) and two-stage least squares. The evidence gathered by the authors favor FIML over the two-stage procedures and both over DLS for structural estimation as well as prediction. The potential use of nonlinear equations in econometric water resource studies make this paper of interest to the water researcher. (Murphy-Rutgers)
W71-00776

COST ANALYSIS OF IMPROVED REGULATION OF THE COLUMBIA RIVER TO IN-

CREASE MINIMUM FLOW IN THE HANFORD PLANT VICINITY,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
R. W. Legan, and R. T. Jaske.
AEC Research and Development Report, BNWL-1343, UC-70, June, 1970, p 69. 25 fig, 2 tab, 3 ref. US AEC Contract AT (45-1)-1830.

Descriptors: Temperature, Regulation, Economics, Flow, Hydrographs, Transmission (Electrical), Annual costs, Electric power, Washington.
Identifiers: Hanford plant, Thermal discharge, Penalities, Flow management.

This report reviews the operational history of the week of October 24-31, 1967 with respect to the actual operations of the Priest Rapids Project and the resulting effects on the flow of the Columbia River. These effects are compared with the degree of management also exerted at the McNary project during the time period. The adverse effects of the uncoordinated regulation of the Columbia River are summarized with respect to Washington State temperature standards. The linear program code UMPIRE was used to model the actual conditions and, by superposition, minimum flow constraints ranging upwards from 36,000 cu ft /sec by 10,000 cu ft /sec increments were imposed on the Hanford reach. All scheduled power and energy demands of the Priest Rapids project and the McNary project that existed on that week were met. The economics suggest that large reductions in the cost of proposed navigation channel facilities can be made by basing the channel design on 66,000 cu ft/sec or higher minimum flows in the Hanford reach. The extra cost for energy losses and management represent a small fraction of the construction cost reduction when capitalized. The study shows the great benefits to multipurpose river use from system coordination on a regional rather than a separate private-federal basis as exists currently. (Upadhyaya-Vanderbilt)
W71-00975

DETERMINISTIC NONLINEAR HYDROLOGIC MODELS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02A.
W71-01081

MULTIVARIATE ANALYSIS IN GROUND-WATER HYDROLOGY -- THEORY,
California State Coll., Long Beach. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02F.
W71-01098

6B. Evaluation Process

COMPARATIVE COST EVALUATION OF DESALTED WATER SUPPLY VERSUS ALTERNATIVE FRESHWATER SUPPLY FROM A CONVENTIONAL SOURCE,
Southwest Research Inst., Houston, Tex.
For primary bibliographic entry see Field 03A.
W71-00569

REORIENTATION OF OUR SALINE WATER RESOURCES THINKING,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 03A.
W71-00576

SYSTEMS APPROACH TO THE EVALUATION OF BENEFITS FROM IMPROVED GREAT LAKES WATER QUALITY,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05G.
W71-00707

FUNCTIONAL EVALUATION OF A WATER RESOURCES SYSTEM,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 06A.
W71-00710

SYSTEMS APPROACHES IN HYDROLOGY AND WATER RESOURCES,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06A.
W71-00727

SOME NEW VIEWS ON THE PAYBACK PERIOD AND CAPITAL BUDGETING DECISIONS
Rochester Univ., N.Y. Coll. of Business Administration.
H. Martin Weingartner.
Management Science: Application, Vol 15, No 12, Aug 1969, p B594-B607. 14 p, 1 fig, 1 tab, 25 ref.

Descriptors: Analysis, Constraints, Budgeting, Capital, Decision making Optimization, Investment, Cost, Time.
Identifiers: *Payback period, Quantitative concepts.

Water resources and other capital budgeting problems are often solved by use of the payback period, when present value or internal rate of return criteria are inadequate. The Payback Period is the time expected for an investment project to recoup its initial cost. In a discussion of this approach the payback concept was considered in its role as a criterion versus a payback constraint, as a break-even concept, and as a crude measure of the rate of resolution of uncertainty. It was shown that the payback reciprocal as a measure of the rate of return of a project had significance in the context of certainty. It was more appropriate to regard payback as a constraint which a project must satisfy than as a criterion which was to be optimized. The inherent differences between financial investments and investments in capital projects by firms were also discussed. (Kriss-Cornell)
W71-00731

INVESTMENT ANALYSIS UNDER UNCERTAINTY
Stanford Univ., Calif. Graduate School of Business.
For primary bibliographic entry see Field 06A.
W71-00734

COMMUNITY GOALS-MANAGEMENT OPPORTUNITIES: AN APPROACH TO FLOOD PLAIN MANAGEMENT
Chicago Univ., Ill. Center for Urban Studies.
John R. Sheaffer, George W. Davis, and Alan P. Richmond.
Community Goals-Management Opportunities: An approach to Flood Plain Development. Washington, D.C.: Center for Economic Studies, U. S. Army Engineer Institute for Water Resources, IWR Report No 70-2, May 1970. 209 p, 15 fig, 3 map.

Descriptors: *Flood Plains, *Methodology, *Planning, *Management, Decision-making, Urbanization, Social aspects, City planning, Cities, Community development.
Identifiers: *Flood plain management, *Comprehensive planning, *Urban development/redevelopment, *U. S. Army Corps of Engineers, Water resource management.

This report focuses on the relationships between flood plain management, comprehensive planning, water resource management and urban development/redevelopment. Its primary purpose is to assist the Corps of Engineers in becoming an active participant in urban development/redevelopment where flood plain management is involved. A four-step decision-making model for analysing flood plain management alternatives is outlined. The normative model is applied to the demands of four case studies. Results point up the benefits which could be realized if flood plain management and urban development/redevelopment were related. Operational and programmatic implications are identified and discussed. (Wexman-Chicago)
W71-00736

THE ECONOMICS OF CLEAN WATER, SUMMARY.
Federal Water Pollution Central Administration, Washington, D.C.

I67.1/2:970 Summary For sale by the Superintendent of Documents, U. S. Government Print Office, Washington, D.C. 20402 Price $0.50 per copy. Report, March 1970. 41 p, 2 fig, 16 tab.

Descriptors: *Economics, *Waste water treatment, *Investment, Decision-making, Political aspects, Social values, Legislation, Evaluation, Chemical wastes.
Identifiers: *Policy decisions, Municipal grant legislation, Economic analysis, Animal wastes.

The basic product of this study is the definition of a rate of investment that will close the gap for municipal and industrial waste treatment within a five year period, given the continued pertinence of today's regulatory and technological conditions. Detailed studies of the pollutional impact of the inorganic chemicals industry and of concentrated animal populations are submitted as separate subreports. Several issues germane to the policy decisions required with expiration of current municipal grants legislation are discussed. Economic analysis can provide insights into the consequences of alternative actions, but the political process must in the final analysis mold the necessary decisions within the context of total national interests and values. (Davis-Chicago)
W71-00737

THE ECONOMICS OF CLEAN WATER, VOLUME ONE.
Federal Water Pollution Control Administration, Washington, D.C.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402 Price $1.50 per copy. I67.112:970 Vol 1. Report March 1970. 168 p, 9 fig, 53 tab, 1 append.

Descriptors: *Economics, *Waste water treatment, *Investment, Costs, Industrial wastes.
Identifiers: Federal assistance programs, Public investment, Regional waste water treatment systems.

This volume addresses itself to the basic question of defining a rate interest that will close the gap for municipal and industrial waste treatment, within a five year period. A number of subsidiary issues are also considered, including the influence of industrial waste discharges on public investment outlays, the influence of location on unit investment, the status of broadly integrated regional waste handling systems, the incidence of recapitalization, the influence of price levels on investment, and patterns of change in the real cost of waste treatment facilities. Consideration of these questions was consistently pointed to their relationship to the problem of deriving a normative annual level of investment, one appropriate to five year attainment of an investment equilibrium in the public waste treatment section; and the force of Federal assistance programs on investments is a minor theme that pervades the report. (Davis-Chicago)
W71-00738

WATER-RELATED FACILITIES STUDY FOR THE COMPREHENSIVE REGIONAL PLAN.
Franklin County Ohio Regional Planning Commission, Columbus, Ohio.

Available from NTIS as PB 189 007, $3 in paper copy, $0.95 in microfiche. Franklin County Regional Planning Commission, Columbus, Ohio, Dec

1969. 137 p, 18 tab, 23 plate, 9 fig. HUD Project Ohio Pa46G X-1105-2.

Descriptors: *Planning, *Water resources, *Water management (Applied), *Water policy, Water supply, Water quality, Sewerage, Drainage, Flood control, Aesthetics, Recreation, Financing.
Identifiers: *Comprehensive planning, *Water resources planning, Implementation, Sewage systems, Regional water authority, Franklin County, Ohio.

This report provides a plan for the development and distribution of water supplies, and for flood control, sewerage and drainage, all on a regional scale. The need for both water supply and flood control is emphasized. Water supplies are to be developed from streams with upground storage reserviors, and from wells. On-stream reservoir sites are proposed as flood control projects. Aesthetic and recreational potentials of such a development are pointed out. Sources of funding are listed and implementation through a regional water authority recommended. (Wexman-Chicago)
W71-00739

THE NORTHEAST OHIO WATER DEVELOPMENT PLAN PROGRAM FOR ACTION,
Ohio Dept. of Natural Resources, Columbus; and Stanley Consultant, Cleveland, Ohio.
S. L. Frost, and Robert H. Anderson.
Water Resources Bulletin, Vol 6, No 4, p 550-555, July-August 1970.

Descriptors: *Water Resources Development, *Water management (applied), Watershed management, Water pollution control, Water supply, Coordination, Social aspects, Economics, Environment.
Identifiers: *Northeast Ohio.

The Northeast region is one of five major water planning management regions in Ohio. Environmental problems associated with the growth of the Northeast Ohio metropolitan region are a serious threat to this heavily populated area. If Northeast Ohio is to continue to grow and be an acceptable and desirable place to live, total systems management of water resources and waste product disposal is a must. The Northeast Ohio Water Development Plan will include water management programs for the next several decades. Guidelines for growth and specific project recommendations will be developed, but with realization that the plan must be flexible and sensitive to changing sociological, economic and environmental conditions. The initial volumes of this report have already been published. It was recommended that the comprehensive plan involve consideration of eight major categories: regional growth, water supply, water quality and pollution control, water reclamation and reuse, recreation, solid wastes, erosion and flood control, and institutions (governmental and financial). The program is designed to take advantage of Federal grants for studies and plan formulation. Separate studies should be undertaken under each of the programs. The Northeast Ohio Water Development Plan would then emerge as a series of reports coordinated and drawn together by a project management team under the guidance of the Dept. of Natural Resources. (Marriott-Chicago)
W71-00740

EVALUATING SUBJECTIVE RESPONSE TO THE RECREATION ENVIRONMENT: A QUANTITATIVE ANALYSIS OF DISSIMILAR PREFERENCES FOR THE VISUAL CHARACTERISTICS OF BEACHES,
Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.
Edward S. Neumann, and George L. Peterson.
Outdoor Recreation Opportunity Needs and Desires, Technical Report no. 1, Evanston, Illinois, February 1970. 176 p, 18 fig, 14 photo, 25 tab, 62 ref. U. S. Public Health Service Grant No 5 R01 EC 00301.

Descriptors: *Mathematical models, *Methodology, *Recreation facilities, *Planning, *Recreation demand, *Beaches, Swimming, Aesthetics, Social aspects.
Identifiers: *Visual characteristics, *Subjective responses.

In order to design an urban environment which will provide maximum benefits at a minimal cost, the planner must develop ways to analyze its effectiveness in meeting a broad range of human needs. Outlined here is a general conceptual and analytical approach to evaluate human response to the visual aspects of the recreation environment. A man-environment interaction is expressed mathematically as R-f (x), i.e., response is a function of environmental characteristics. An outline is made of methodological techniques with three structures indicated: response is quantitatively modeled in a manner which permits analysis of differences among individuals; environmental characteristics are modeled in a manner which permits analysis of the differences which may exist among different types of environments; mathematical transformations are used to specify the relationships between response, environmental characteristics, and other attributes of the individual. In the first chapter a man-environment response relationship is hypothesized with a series of simulated beach environments and a sample of beach users utilized to test and verify the model. Next, relationships between user response and other user attributes are examined to determine whether subjective preference is also related to other variables relevent for evaluating environmental effectiveness. Finally, the hypothesized mathematical preference model is examined to determine its strong and weak points. (Preckwinkle-Chicago)
W71-00742

REVIEW AND INTERPRETATION OF EXPERIENCES IN WATER RESOURCES PLANNING,
Resources for the Future, Inc., Washington, D.C.
Irving K. Fox.
In: Organization and Methodology For River Basin Planning, Atlanta, Georgia Institute of Technology, 1964, p 61-88.

Descriptors: *Planning, *Water resource development, *River basins, Canals, Government, Rivers, Water law, Federal jurisdiction, Tennessee Valley Authority, Costs, Economic evaluation, Optimization, Economic efficiency, Benefit cost analysis.
Identifiers: *Planning history, *Pre-World War II planning, *Post World War II planning, *Value optimization, *Administrative efficiency.

In this paper the author presents his interpretation of the significance of recent studies and experience for water resources planning in this country. The first part of the paper presents a broad overview of the main features of past water resources planning up to World War II. The second part is concerned with water resources planning since that time and seeks to examine the alternative approaches which have been used in recent years. The author distinguishes the six approaches which have been attempted and evaluates them on the basis of their administrative efficiency as well as their economic efficiency. (Murphy-Rutgers)
W71-00743

ORGANIZATION AND METHODOLOGY FOR RIVER BASIN PLANNING.

Atlanta, Georgia, Water Resources Center, Georgia Institute of Technology, 1964, 561 p.

Descriptors: *Planning, *River basin development, *Management, *Government, Economic evaluation, Hydrology, Rivers, Flood control, Recreation, Cost, Water supply, Water pollution, Navigation, Hydro-power, Irrigation, Conservation, Engineering, Financing, Optimization, Social aspects.
Identifiers: *U. S. Study Commission, *Southeast River Basins.

This book is based on the results of a seminar and represents a number of opinions regarding the state of the art of comprehensive river basin planning. Specific attention is given to the completed work of the U. S. Study Commission (USSC) for the Southeast River Basins (SERB). The history of the USSC-SERB is presented and a summary description of its report is provided in the introduction. The book is organized in the same manner as the seminar and consists of papers presented on the USSC-SERB experience as well as on the general nature of river basin planning. These are followed by several discussants presenting critical evaluations of the main paper. The background and perspective in Federal river basin planning is discussed followed by papers on the organization and procedures of the USSC. The basic studies concerned with the economic, hydrologic, climatic, engineering, geology and cost aspects are explained and criticized. Functional studies dealing with the specific aims and objectives of river basin planning are also given. The different aspects of plan preparation are then discussed and in the final section, there is an evaluation of USSC-SERB program. (Murphy-Rutgers)
W71-00744

WATER SUPPLY, ECONOMICS, TECHNOLOGY AND POLICY,
California Univ., Los Angeles; Rand Corp., Santa Monica, Calif.; and Indiana Univ., Bloomington.
Jack Hirshleifer, James C. DeHaven, and Jerome W. Milliman.
Chicago, University of Chicago Press, 1969, 386 p.

Descriptors: *Water supply, *Economic evaluation, *Technology, Prices, Water quality, Hydrology, Water distribution, Natural resource allocation, Economic justification, Costs, Marginal costs, Average costs, Time, Risks, Taxes, Government, Capital costs, Desalination, Irrigation, Flooding, Water law, Decision making, Economic efficiency, Economic welfare.
Identifiers: *New York, *California, Feather River, Hudson River.

This book provides an introduction to the application of economic and technological knowledge to the solution of practical problems in the area of water supply. The water problem as it pertains to the future availability, price, and quality of water is discussed followed by an explanation of the present state of water resources development. The authors apply economic analysis to the problem of utilizing existing water supply and explain and criticize the usual allocation process. Theoretical principles of correct pricing are applied in the practical context of municipal water utilities and present industry pricing practices are criticized. The authors investigate the theoretical criteria for determining when expansions of water supplies should take place and which of the many technologically possible projects should be adopted. The portions of the hydrologic cycle from which supplies of water may be obtained are discussed as well as the technological propspects and the costs of procuring, treating and distributing water in a variety of ways. Following an explanation of the relevant water law, there are two case studies of areas which experiences a water shortage. (Murphy-Rutgers)
W71-00745

VALUES AND CONCEPTS IN CONSERVATION,
Oregon Univ., Eugene.
Edward T. Price.
In: Readings in Resource Management and Conservation, edited by Burton, Ian and Kates, Robert W., Chicago, University of Chicago Press, 1965, pp 237-254.

Descriptors: *Natural resource development, *Conservation, Resource allocation, Government, Population, Water power, Air pollution, Land, Technology, Economic evaluation, Waste, Risk, Taxes, Social aspects.
Identifiers: *Laissez-faire, Time preference, Socialization.

This article considers the ideological foundations of natural resource conservation as a means to future material welfare. The author considers certain basic values and ideas, such as limitations on the future of primitive man, the expanding future of industrial man, self-identification with the people of the future, and the population of the future. The conventional concepts of resources and the limits of natural resources are surveyed. Based on these results, objectives of conservation policy are suggested. Some of these include: even utilization over all time, preference for the present, prevention of waste, protection of potential resources, and group effect on resources. Conservation techniques in both capitalistic and communistic economies are compared and used to show the need for government intervention in conservation problems. This need arises from the failure of laissez-faire in the area of resource use by the individual who closes pragmatism over conservation. This article has general relevance to water resources by providing background thoughts on the conservation theme. (Murphy-Rutgers)
W71-00746

THE CONTRIBUTION OF PAST METHODS TO PRESENT DAY PLANNING,
Victoria Univ. (British Columbia).
W. R. Derrick Sewell.
In: Regional Planning-Challenge and Prospects, ed. by Hufschmidt, M. M. New York, Frederick A. Praeger, 1969, p 92-97.

Descriptors: *Planning, *Environmental effects, *Water quality control, Recreation, Water pollution, Air pollution, Technology, Floods, River basins, Investments.
Identifiers: *Flexibility, Uniformity, Resource utilization, Social scientists.

The author discusses the present state of the planning industry in such widely diverse areas as traffic congestion, urban sprawl, water and air pollution, and outdoor recreation. The goal of all these planners is environmental quality, and the author suggests a need for some type of comprehensive environmental planning to organize these various planners and goals. Three major aspects of such comprehensive planning are discussed. First is the scope and content of such planning. The need for flexibility is pointed out, and defended by study of the river basin plan. The article also notes that complete environmental control is neither possible nor desirable. The second major problem concerns who will perform comprehensive planning. The author proposes either a group of well-rounded 'superplanners' or a group composed of experts from individual fields. Finally, the author discusses when comprehensive planning may become a reality. He suggests that the water resources field has provided good examples of what (or what not) to do since the 1930's. This experience provides significant assistance to present day comprehensive planners. (Murphy-Rutgers)
W71-00748

THE EFFICIENT PRODUCTION OF EXTERNAL ECONOMIES,
Maryland Univ. College Park; and Harvard Univ., Cambridge, Mass.
Mancur Olson, and Richard Zuckhauser.
American Economic Review Vol LX, No 3, p 512-517, June 1970.

Descriptors: *Welfare economics, *Economic evaluation, *Economies of scale, *Diseconomies of scale, *Spillovers, Cost minimization, Social aspects, Optimization, Resource allocation, Economic efficiency, Prices.
Identifiers: *Externalities, *Pareto optimality, Market adjustment, Collectivization.

External economies are often present in the water utility and hydroelectric power industries. This condition may yield the conclusion that regulation is necessary in order to achieve Pareto optimality. However, this conclusion has recently been rejected by some economists. This paper argues that the conclusion is valid and that those who do not agree have failed to understand that external economies are produced with different degrees of efficiency and that independent adjustment will generally lead to an inefficient level of output as well as an inefficient method of production. Thus, society is forced to pay more for the suboptimal supply of the good than it would have to pay for the larger amount which an ideal collective arrangement would provide. The paper concludes by presenting some theoretical and policy insights suggested by the analysis. (Murphy-Rutgers)
W71-00749

EXCLUSION COSTS, EXTERNAL ECONOMICS, AND MARKET FAILURE,
Manchester Univ. (England).
R. Millward.
Oxford Economic Papers Vol 22, No 1, p 25-38, March 1970.

Descriptors: *Costs, *Benefits, *Economic efficiency, *Welfare economics, Production, Prices, Equilibrium, Joint costs, Demand, Economies of scale, Maximization, Model studies.
Identifiers: *Exclusion costs, *Public goods, *Externalities, Pareto efficiency.

The author seeks to examine the role of the exclusion principle in the explanation of external economics. A static social welfare maximization model is presented and the reasons why the circumstances of either increasing returns to scale or the presence of externalities precludes achievement of a welfare optimum are explained. The relationship between externalities and joint supply are explored and a distinction made between production costs and exclusion costs. To the extent that all marketed goods and services involve some exclusion costs, then efficient solutions are never attainable by market system. Only an economy ruled by a dictator, with complete knowledge of consumer preferences, could achieve the best solution. The exclusion problem is clearly present in the water resources area. The principles discussed in this paper should provide the planner of public water resource investments with a theoretical framework in order to evaluate the exclusion problems involved with certain uses of water (e.g. outdoor recreation). (Murphy-Rutgers)
W71-00750

THE ABANDONMENT DECISION UNDER UNCERTAINTY,
Norwegian School of Economics and Business Administration, Bergen.
Carl J. Nostrom.
Swedish Journal of Economics, Vol 72, No 2, p 124-129, June 1970.

Descriptors: *Risk, Optimality, Markov processes, Discount rate, Probability.
Identifiers: *Abandonment, Expected cash flow, Dynamic programming capital budgeting, Present value, Matrix.

The essential characteristic of the abandonment problem is that the decisions are made sequentially and under uncertainty. The author considers two approaches to this problem. The objective of the firm is to find a method which maximizes, at a given rate of discount, the expected present value of the total cash-flow resulting from the equipment to be abandoned. The Expected Cash-Flow (ECF) approach maximizes the present value of keeping and then selling equipment to satisfy optimality conditions. The author demonstrates the decision given by the ECF method is not optimal and leads to a tendency to sell too soon. The Dynamic Programming (DP) approach equals the expected value of equipment to abandonment time. This approach gives correct results but may not be feasible because of the complexity of the calculations. However, Markov programming may be helpful in some cases toward a solution. When the ECF decision is to keep the equipment, the DP decision is consistent. Thus, it is not necessary to know the optimal policy. This discussion may prove helpful to water planners concerned with capital budgeting. (Siegenthaler-Rutgers)
W71-00761

RESOURCE ALLOCATION AND THE REGULATED FIRM,
Bell Telephone Labs., Inc., Murray Hill, N.J. Data System Engineering Div.
Elizabeth E. Bailey, and John C. Malone.
Bell Journal of Economics and Management Science, Vol 1, No 1, p 129-142, Spring 1970.

Descriptors: *Resource allocation, Regulatory constraints, Capitalization.
Identifiers: *Regulated firm, Fair return on investment, Profit maximization, Monopoly firm, Mark-up, Lagrangian function.

The regulated firm is considered under a variety of management objectives and regulatory constraints to analyze the effects of the constraints and objectives on resource allocation. The alternative management objectives are profit maximization, sales maximization, return on investment and output. The regulatory constraints are fair return on investment, fair mark-up on costs, fair profit per unit production and fixed profit. The Lagrangian function for each objective is formulated subject to the constraints. The results indicate profit-maximizing firms subject to fair return investment overcapitalize with sales maximizing firms undercapitalizing. Companies subject to a fair return on investment use a nonminimum cost allocation of resources regardless of the management objectives used. Whether the fair return on investment is a management objective or a constraint, there is undercapitalization. The fair mark-up on costs and fixed profit constraints tend to encourage nonproductive resource use when demand is inelastic. The fair profit per unit production is the only constraint guaranteeing minimum cost operation by a profit or sales maximizing firm. This constraint results in efficient resource allocation and discourages the maintenance of nonproductive resources. This analysis is relevant for water planners concerned with economic efficiency in water utility management. (Siegenthaler-Rutgers)
W71-00762

CONSTRAINTS ON PUBLIC ACTION AND RULES FOR SOCIAL DECISION,
Princeton Univ., N.J.
David F. Bradford.
American Economic Review, Vol LX, No 4, p 642-654, September 1970.

Descriptors: *Decision-making, *Cost-benefit analysis, Welfare economics, Public investment, Rate of return, Constraint.
Identifiers: *Dorfman paradox, Social discount rate, Perpetuity value, Present value, Time preference.

This paper is concerned with an analysis of the Dorfman paradox and more generally the prescriptive forces of cost-benefit analysis. In his research on project-specific social discount rates, Robert Dorfman presents two formulas, one using present values and the other equivalent annual perpetuity streams to generate a social discount rate for use in public investment decision-making. Although the two formulas are symmetric, they yield different values for the social discount rate and lead to different social investment choices. This paradox arises because a competitive equilibrium does not hold in the production and distribution of dated goods or there is an imperfect capital market. For social decision-making, the effect on the income distribution must be considered along with the benefit-cost ratio calculation. For the Dorfman paradox, the appropriate social discount rate will hinge on the type of income transfers considered feasible or in other words, the constraints of social action. Thus, cost-benefit analysis is not adequate as a screening device because it does not give enough details on the gains and losses resulting

from an investment decision. This discussion is of interest to water projects employing a cost-benefit framework for decision-making. (Siegenthaler-Rutgers)
W71-00764

UNCERTAINTY AND THE EVALUATION OF PUBLIC INVESTMENT DECISIONS,
Harvard Univ., Cambridge, Mass.; and Stanford Univ., Palo Alto, Calif.
Kenneth J. Arrow, and Robert C. Lind.
American Economic Review, Vol LX, No 3, p 364-378, June 1970.

Descriptors: *Public investment, *Risk decision-making, Discount rate, Interest rate, Optimization.
Identifiers: *Expected return, Asset holding, Capital market, Pooling.

The authors take the position that risk should be discounted in the same way for public investment as it is for private investment. Using Hirshleifer's work as a basis, a state perference model approach is presented. The article, assuming perfect capital markets, demonstrates that the government should behave as an expected-value decision maker. In the absence of perfect markets, the author presents an approach where individual preferences are relevant for public investment decisions. The article also argues that when risks associated with public investment are publicly borne, the total cost of risk-bearing is insignificant. Thus, the government should ignore uncertainty in public investment evaluation. The discount rate chosen also should be independent of risk. These results are obtained because the government distributes the risk associated with any investment among a large number of people. This discussion is of interest to water research efforts concerned with the investment decision-making process. (Siegenthaler-Rutgers)
W71-00765

CAPITAL RATIONING AND EXTERNAL DISCOUNT RATES,
New York Univ., N.Y.
Edwin J. Elton.
Journal of Finance, Vol XXV, No 3, p 573-584, June 1970.

Descriptors: *Decision making, *Capital market, Linear programming, Market value, Constraint, Rate of return.
Identifiers: *Capital budgeting, *External discount rate, Capital rationing, Cash flow, Objective function, Transaction costs, Asset selection.

This paper contends that external discount rates are important to a firm operating under capital rationing. This position is contrary to previous research. Capital rationing occurs when the firm has no external borrowing opportunities, but the firm's stockholders do have access to capital markets. The author argues that the indifference utility curve for a stockholder depends on the market time or external discount rate for firms of the same risk. This is so because in capital rationing the lending and borrowing curve does not exist. He discusses mathematical programming models for a firm operating under capital rationing and demonstrates that the reinvestment rate depends on the objective function assumed. Since the market discount rate is the appropriate rate to discount cash flow from the firm, the market or external discount rate affects the project selection process. Although a firm may be unwilling to go to the capital market for new funds, the firm is still valued in the market: Thus, capital budgeting precriptions should not ignore the impact of the firm's capital budgeting decision on current market price. This article is relevant to capital budgeting and investment decisions in the water area. (Siegenthaler-Rutgers)
W71-00777

SURVEY OF CAPITAL BUDGETING: THEORY AND PRACTICE,
British Columbia Univ., Vancouver.
James C. T. Mao.
Journal of Finance, Papers and Proceedings, Vol XXV, No 2, p 349-360.

Descriptors: *Decision making, Optimization, Risk, Discount rate, Probability.
Identifiers: *Capital budgeting, Mathematical programming, Cash flow, Present value, Internal rate of return, Payback period, Accounting profit, Certainty equivalent approach.

Wide disparaty exists between the theory and practice of capital budgeting. The theory of optimal investment decisions is premised on the existence of an objective function which the firm maximizes. Current financial theory assumes the firm should maximize the market value of its common shares. The results of firm case studies conducted by the author are consistent with theory on the objective of financial management. In capital budgeting theory, risk is generally measured by the variance of investment return; however, the author suggests the use of semi variance because it is consistent with measurement of the opportunity cost of capital and the case study findings. Theory incorporates risk into investment analysis through either the certainty equivalent approach or the risk-adjusted discount rate method. In practice, firms incorporate risk through the risk-adjusted discount approach. While theorists recommend the internal rate of return or net present value criterion for investment appraisal, the study confirms the prevalence of the payback period and accounting profit criteria in practice. To make theory more operationally meaningful, the author suggests the development of a dynamic model of decision-making, accurate estimates of cash flow, and more stress on growth objectives. This article is relevant to water policy makers concerned with the investment decision process. (Siegenthaler-Rutgers)
W71-00778

THE PROSPECTIVE GROWTH RATE AS A MEASURE OF ACCEPTIBILITY OF A PROPOSAL,
Stanford Univ., Palo Alto, Calif.
R. V. Oakford.
Engineering Economist, Vol 15, No 4, p 207-216, Summer 1970.

Descriptors: *Decision-making, Capital investment interest rate.
Identifiers: *Capital growth rate, Cash flow series, Present worth, Benefit series.

The prospective capital growth rate in financial transactions is specified as an interest rate and is defined as the rate of growth of capital which remains invested in a proposal. If the proposal involves borrowing then the prospective growth rate is the rate at which the unpaid capital balance grows. The author shows that the use of the growth rate as a measure of the attractiveness of a proposal differs depending upon whether the project represents an increment of investment or borrowing. If cash flow represents an increment of investment, a decision-maker should invest if the capital growth rate is greater than the marginal growth rate. If however, the cash flow represents borrowing and the growth rate is larger than the marginal rate, the decision is to reject the increment of borrowing. If the cash flow does not fall into the above two categories, and the decision rule is inapplicable to the formal relationship between present worth and prospective growth rate. With proper application, the two decision criteria will yield the same results for project evaluation except when the cash flow series cannot be identified as an investment increment or borrowing increment. This discussion is relevant to water planners involved with project proposals. (Siegenthaler-Rutgers)
W71-00780

MORE ON THE SOCIAL RATE OF DISCOUNT,
North Carolina State Univ., Raleigh.
J. A. Seagraves.
Quarterly Journal of Economics, Vol LXXXIV, No 3, p 430-450, August 1970.

Descriptors: *Discount rate, *Investment, *Economic evaluation, *Risk, *Government, Taxes, Cost, Cost-benefit analysis, Maximization, Interest rate, Capital, Decision-making, Computers.
Identifiers: *Social rate of discount, *Rate of return, Opportunity cost, Inflation.

The author is concerned with the question of how a given level of investment should be allocated among projects. He interprets the social rate of discount as a minimum rate of return which government projects hould achieve. The selection of this rate of discount is often a difficult task in the evaluation of water resource investments and the provision, by this author, of practical economic criteria for selecting among investments, should be of particular interest to the water resource planner. He recommends the calculation of real internal rates of return and continual reranking of projects by individual agencies and the Bureau of the Budget. The social opportunity cost of capital is estimated by first using the yield on Class A Corporate bonds to represent the risk-free earnings of the private sector after taxes. A risk premium and a tax factor are then added and a factor subtracted for the lower rate earned on additional savings and the expected future rate of inflation. The discount rate controversy has important implications for water investment decisions. Accordingly, this article is relevant to the investment analyses of water resources. (Murphy-Rutgers)
W71-00782

RICHMOND REGIONAL WATER PLAN. AREA WIDE PLAN FOR LONG RANGE DEVELOPMENT.
Richmond Regional Planning District Commission, Va.
For primary bibliographic entry see Field 06D.
W71-00804

RECOMMENDED REGIONAL PLAN FOR SEWERAGE, WATER SUPPLY AND STORM DRAINAGE.
Valley Regional Planning Agency, Ansonia, Conn.

Available from NTIS as PB-192 940, $3.00 in paper copy, $0.95 in microfiche. February 1970. 60 p. append. Illus. HUD Project Conn. P-103.
Identifiers: *Urban planning, *Connecticut, *Sanitary engineering, Urban areas, Sewage, Drainage, Floods, Control, Water supplies, *Regional planning and development, *Storm sewers, Water resources.

The report presents the recommended regional plan and program for sewerage, water supply and storm drainage for the 58 square mile Valley Planning Region, comprising Ansonia, Derby, Seymour, and Shelton, Connecticut. (See also W71-00820)
W71-00819

STORM DRAINAGE: INVENTORY AND ANALYSIS OF MAJOR EXISTING AND PLANNED FACILITIES. VOLUME V: STORM DRAINAGE.
Valley Regional Planning Agency, Ansonia, Conn.

Available from NTIS as PB-192 942, $3.00 in paper copy, $0.95 in microfiche. February 1970. 18 p. Diagr. Illus. HUD Project Conn. P-103.
Identifiers: *Urban planning, *Connecticut, *Drainage, Urban planning, Floods, Protection, Sewage, Sanitary engineering, *Regional planning and development, *Storm drainage, *Sewers.

The fifth of a five-volume report that is being utilized as part of the basis for an areawide water/sewer plan and program for the Valley Region. This volume includes an inventory and evaluation of the major existing and planned facilities. The inventory includes a delineation of present areas served by storm sewers and areas requiring flood protection. (See also W71-00819)
W71-00820

A MASTER WATER PLAN FOR UNION COUNTY, NEW JERSEY.
Union County Planning Board, N.J.
For primary bibliographic entry see Field 03D.
W71-00825

WATER SUPPLIES AND WATER FACILITIES IN UNION COUNTY.
Union County Planning Board, N.J.
For primary bibliographic entry see Field 03D.
W71-00826

SUSQUEHANNA RIVER BASIN STUDY--A PREVIEW.
Susquehanna River Basin Study Coordinating Committee, Baltimore, Md.
For primary bibliographic entry see Field 04A.
W71-00852

SECONDARY ECONOMIC IMPACT FROM WATER RESOURCES DEVELOPMENT, A CASE STUDY OF FLAMING GORGE RESERVOIR,
Utah State Univ, Logan.
Andrew Bacdayan, and R. S. Whaley.
Available from NTIS as PB-195 439, $3.00 in paper copy, $0.95 in microfiche. November, 1969. 44 p, 10 tab, 6 charts. Utah Resources Series 50. OWRR Project B-003-UTAH (1).

Descriptors: *Cost-benefit analysis, Reservoir sites, Attitudes, Utah, Wyoming, Behavior, *Benefits, *Social aspects, Political aspects, Motivation.
Identifiers: Flaming Gorge Reservoir.

The study was limited to a descriptive analysis of the changes in the area surrounding Flaming Gorge. It resulted in several conclusions and recommendations: To study the impact of a project it is almost essential to wait until the new equilibrium has been reached. The downward trend in most of the economic indicators that resulted from the termination of construction activities at Flaming Gorge lasted about 3 years. The rates of increase in local government incomes and expenditures of the study area were substantially greater than for the rest of the state.
W71-00888

RECREATIONAL IMPACT OF RECLAMATION RESERVOIRS,
Denver Research Inst., Colo. Industrial Economics Div.
J. Gordon Milliken, and H. E. Mew, Jr.
Bureau of Reclamation, Department of Interior Summary Report, March 1969. 18 p, 4 fig, 14 photo, 4 ref.

Descriptors: *Recreation, *Reservoirs, Colorado, *Economic impact, *Social impact, Recreation demand, Recreation facilities, Swimming, Boating, Camping Water skiing, Water sports, Fishing, Lakes, Multiple-purpose projects, Parks, Economics, Reservoir operation, Scenery, Soical aspects, Use rates.
Identifiers: Lake Granby (Colo), Shadow Mountain Lake (Colo), Horsetooth Reservoir (Colo).

The economic and social impacts of reservoir recreation were explored at three colorado reservoirs during 1968, about 20 years after their construction by the Bureau of Reclamation. Two of the reservoirs, Shadow Mountain Lake and Lake Granby, are adjacent to a scenic natural lake and near Rocky Mountain National Park, where they augment a pre-existing mountain resort area. The other reservoir, Horsetooth, is located at the edge of the foothills near a city of 40,000 persons. Horsetooth Reservoir brought new water-based recreation to a relatively arid part of northeastern Colorado. The study had two major purposes. First, to help improve understanding of some secondary economic and cultural effects of water development porjects, as contrasted to primary economic effects such as irrigated crop production and hydro hydroelectric power generation. Second, to help provide a basis for better quantitative estimates of recreational values in determining the multiple benefits of projects. (Knapp-USGS)
W71-00893

A HYDROLOGIC INVENTORY SYSTEM,
State Univ. of New York, Binghamton. Dept. of Geology.
For primary bibliographic entry see Field 07A.
W71-01097

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

RISING WATER VALUES THAT RESULT FROM INCREASED MOBILITY,
Utah State Univ., Logan. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 03F.
W71-00684

THE ALLOCATION AND PRICING OF WATER IN A RIVER BASIN,
University of New England, Armidale (Australia). Dept. of Economic Statistics; and Guelph Univ. Dept. of Agricultural Economics.
J. W. B. Guise, and J. C. Flinn.
American Journal of Agricultural Economics, Vol 52, No 3, p 411-421, August 1970. 3 tab, 35 ref.

Descriptors: *Planning, *Water allocation (Policy), *Pricing, *Economic feasibility, *Water management (Applied), Semiarid climates, Irrigation districts, Irrigation efficiency, Irrigation programs, Water rates, Equilibrium prices, Unit costs, Value, Social impact, Competing uses, Competitive prices, Economic efficiency, Economic justification, Economic prediction, Model studies, Constraints, Equations, Water resources development, River basin development.
Identifiers: *Australia, *Econometrics.

Large scale water resources development involves the administration of diverse and often competing objectives. Efficiency and quality may be enhanced by the development of an econometric model from which optimal short-run allocation and pricing patterns may be derived. The most appropriate type of model is a competitive partial equilibrium framework using nonlinear programming and with the maximization of social payoff as the specified primary objective function. The degree of attainment of this primary objective would be limited by 2 types of constraint: (1) Political and legal (2) Physical and technical, involving the system of supply, storage and reticulation of water. Developed first was a finite horizon deterministic model for an intraseason situation involving competing demands from irrigation areas and a hydroelectric plant. Later, using empirical data, the model was applied to the Murumbidgee Irrigation Area of New South Wales. The mathematical model and the abstracted empirical data are described. From the solutions obtained, it was concluded that: (1) If resource misallocation is to be minimized, historically determined irrigation water prices are in urgent need of revision and (2) Shadow price information relevant to public policy formation may be generated by such a model. (Casey-Arizona)
W71-00688

POLLUTION, PURIFICATION AND THE THEORY OF EXTERNAL EFFECTS,
Stockholm Univ., Sweden.
Peter Bohm.
Swedish Journal of Economics, Vol 72, No 2, p 153-166, June 1970.

Descriptors: *Taxes, *Pollution, Marginal cost, Average costs, Profit, Feasibility.
Identifiers: *External effects, Net benefits, Connection costs.

This paper discusses the choice between taxation and centralized purification as a means of regulating pollution. External effects theory, indicates that efficient resource allocation is obtained by imposing a tax on polluters equal to the value of the marginal external effects. This solution results in an optimal level of pollution but doesn't yield positive net benefits. The tax approach may not be valid when the central purification alternative is feasible. When negative marginal external effects are present, the central purification solution is superior to taxation as long as the net benefits from purification are greater than those from taxation, and moreover the optimal marginal cost price for purification is below or above the tax and the external effects are increasing or decreasing. However, the purification scheme is not preferable to the above tax scheme in the case of a decreasing cost industry or when there are increasing negative marginal external effects. This article is of practical importance in providing theoretical guidelines for policy measures to reduce pollution. (Seigenthaler-Rutgers)
W71-00752

ECONOMIC EFFICIENCY IMPLICATIONS OF FEDERAL-LOCAL COST SHARING IN WATER RESOURCE DEVELOPMENT,
Economic Research Service, Washington, D.C.
Harold Emory Marshall.
Water Resources Research, Vol 6, No 3 p 673-682, June 1970.

Descriptors: *Economic efficiency, *Cost sharing, Cost-benefit analysis, Expenditures, Water resource development, Budget constraint.
Identifiers: *Association rule, Public good, User charge, National efficiency benefit, Social benefit, Social cost.

The exact relationship between existing federal cost sharing rules and their efficiency aspects and equity considerations with respect to water resource development are not clearly defined. The problem is whether present cost sharing rules have the effect of inducing local parties to maximize national efficiency benefits or to demand projects that maximize local interests. The Army Corps of Engineers, the Bureau of Reclamation, and the Soil Conservation Service who are involved with cost sharing rules have inconsistent policies and practices on this subject. These inconsistencies have enabled local groups to look for the lowest cost share and thus select production techniques that are socially inefficient. To remedy this situation, the article suggests the use of the association rule that costs be shared in the same proportion as benefits at the margin. Through the use of the association rules and consistent cost sharing rules, local groups can be induced to select socially efficient projects. More specifically, the introduction of higher local cost shares and user charges are mentioned. The implementation of these suggestions would lower social expenditure and result in higher local shares in water resource development. (Siegenthaler-Rutgers)
W71-00755

SOME BEHAVIORAL CHARACTERISTICS ASSOCIATED WITH RESIDENTIAL WATER PRICE CHANGES,
John Hopkins Univ., Baltimore, Md.
Steve H. Hanke.
Water Resources Research Vol 6, No 5, p 1383-1386, October 1970.

Descriptors: *Prices, *Water demand, *Measurement, *Instrumentation, *Sampling, Sprinkling, Domestic water, Social aspects, Economic evaluation, Planning, Time, Water conservation, Income, Water rates, Water management, Statistics.
Identifiers: *Boulder, Colorado, *Interviewing, Socioeconomic aspects.

In this report the author describes the specific types of changes that occurred in consumer behavior after incremental water prices were introduced in

Boulder, Colorado. Interviews were obtained from a random sample of 180 customers. The responses indicated that consumers modified their behavior to take account of the incremental charges. Conservation of water use also increased with time as consumers began to make substitutions and more efficient use of water. Socioeconomic characteristics were found to play a small part in determining attitudes toward meters and water. The author feels that these results enable water managers to more accurately predict behavioral adjustments to water price changes. (Murphy-Rutgers)
W71-00759

MARGINAL COST PRICING WITH JOINT COSTS,
Graduate Centre for Management Studies, Birmingham (England).
J. C. Littlechild.
Economic Journal, Vol LXXX, No 318, p 323-335, June 1970.

Descriptors: *Joint costs, Marginal costs, Demand function, Mathematical programming, Constraint optimality.
Identifiers: *Peak-load pricing, Cost minimization, Consumer surplus, Producer surplus, Joint product.

The author first considers Ralph Turvey's research on the problem of marginal cost pricing with joint products in the context of peak-load pricing. The author shows the optimal rules developed by Turvey can also be derived via programming methods. At optimality, the marginal cost of output in any period equals its marginal cost but the result is indeterminate in the case of equal outputs. The reason for the possible indeterminacy is that production over time is essentially a joint product of durable capital equipment. This is remedied by incorporating demand functions as well as costs into the analysis by maximizing the present value of the producer and consumer surplus subject to capacity constraints. The appendix demonstrates with a technology slightly different from Turvey's under certain conditions decision rules can be obtained whereby marginal cost in any period depends on the values of the parameters as given in that period only. This analysis is relevant for water studies concerned with pricing and investment decisions under uncertainty. (Siegenthaler-Rutgers)
W71-00763

THE PEAK-LOAD PROBLEM: DAVIDSON'S SOLUTION RECONSIDERED,
Georgia Univ., Athens.
Donald Ray Escarraz.
Quarterly Review of Economics and Business, Vol 10, No 2, p 85-90, Summer 1970.

Descriptors: *Peak load, Economic efficiency, Public utilities, Joint costs.
Identifiers: *Marginal cost pricing, Average cost, Plant capacity, Distributional equity.

The peak load problem is concerned with the establishment of utility rates which satisfy the criteria of economic efficiency and distributional equity. The author examines Ralph Davidson's work on this subject. Davidson's solution is to equate period price to long run marginal cost of the same period. The model is based on the concept that off-peak demand and peak demand exist for the same product in different markets with peak demand and peak costs in the primary market determining output and plant capacity. The author finds that the separate market assumption implies price discrimination between time periods because monopoly control prevents price equality. Furthermore, it is shown that Davidson's full cost assumption involves average and not marginal cost pricing. As an alternative, it is suggested the peak load problem might be studied from the view of joint costs and that plant capacity be determined by long run demand and short run supply. The existence of peak demand conditions for water make this article relevant to water research efforts concerned with pricing policies. (Siegenthaler-Rugers)
W71-00767

ON OFF-PEAK PRICING: AN ALTERNATIVE SOLUTION,
Pennsylvania Univ., Philadelphia.
Sidney Weintraub.
Kyklos, Vol XXIII, No 3, p 501-519, 1970.

Descriptors: *Peak load, Marginal costs, Average cost, Economic welfare.
Identifiers: Pareto optimal, User costs, Firm-peak, Free rider, Shifting-peak.

Oscillations in demand for public utility services make it difficullt to devise a rate structure for efficient use of facilities while maintaining pricing equity among different users. This phenomenon is known as the peak-off-peak (P-O-P) pricing problem. The varying prices are attributable to heavy capital costs and relatively unimportant user costs. The author examines Steiner's work on the P-O-P problem. Steiner distinguishes between two cases in his analysis; first a shifting peak where output is uniform at both times but price varies and secondly, a firm peak where prices at peak cover full costs but at off peak, the price is zero. The shifting peak case is criticized because shifting prices violate the Pareto optimal rule since price is not equal to marginal cost. The firm peak case involves free riders because output is free to off-peak users, a result which may be unsatisfactory on equity grounds. An alternative suggested by the author is a pricing policy which maximizes the sum of peak plus off-peak output so this results in a benefit to both groups. This article is of interest to water utility administrators concerned with pricing policy. (Siegenthaler-Rutgers)
W71-00768

THE PEAK LOAD PROBLEM WITH INCREASING RETURNS AND PRICING CONSTRAINTS,
Minnesota Univ., Minneapolis.
Herb Mohring.
American Economic Review, Vol LX, No 4, p 693-705, September 1970.

Descriptors: *Peak load, Resource allocation, Marginal cost, Constraint.
Identifiers: *Social welfare function, Objective function, Scale economies, Quasi-rents.

The variation on the demand for services rendered by public utilities is the subject of this paper. The author shows that the rules for efficient allocation of resources used in the production of peak load commodities are same as those for commodities not subject to short run variations in demand. For both types of commodities, the revenues derived from marginal cost prices will just equal total costs, if and only if, production is characterized by constant returns to scale. In practice, the pricing and investment policies for producing peak load commodities violate the rules for efficient resource allocation. The author develops optimization rules for situations in which one or a combination of pricing restrictions are imposed on government agencies providing a public utility service. First, a deficit constraint is imposed on the production of the public utility service with the result that optimization no longer yields price equal to marginal cost. Next, the deficit constraint and a single price constraint are imposed on the model, with results that revenues no longer equal costs. Finally, the single toll constraint yields a inequality between prices and marginal costs. This analysis is relevant to water planners concerned pricing policies. (Siegenthaler-Rutgers)
W71-00769

SHORT-RUN COST FUNCTIONS OF A MULTI-PRODUCT FIRM,
Pennsylvania State Univ., University Park.
Ronald S. Koot, and David A. Walker.
Journal of Industrial Economics, Vol XVIII, No 2, p 118-128, April 1970.

Descriptors: *Cost function, Marginal cost, Linear programming, Constraint, Least squares regression analysis.
Identifiers: Multi-product, Full capacity, Quadratic, Autocorrelation.

In economic theory, the short run average and marginal cost curves of a firm are U-shaped according to the principle of diminishing returns. Empirically the U-shape is only one hypothesis of the form of the cost function. In this paper, linear, quadratic, and cubic cost functions are tested for a multi-product manufacturing firm using the method of single equation least squares. The results indicate that the short-run total cost functions are linear for each product and for the firm as a whole. The implication is that marginal and average variable costs are constant over the observed range of putputs. The linearity of the total cost function makes it possible to construct linear programming models and decision models. The techniques of this paper have relevance to empirical cost studies of water supply conditions. (Siegenthaler-Rutgers)
W71-00779

THE THEORY OF PUBLIC UTILITY PRICING AND ITS APPLICATION,
Chicago Univ., Ill.
Ronald Coase.
Bell Journal of Economics and Management Science, Vol 1, No 1, p 113-128, Spring 1970.

Descriptors: *Public utility pricing, Marginal cost, Average costs.
Identifiers: *Multipart pricing, Subsidy.

The use of marginal cost pricing is considered as a solution to the public utility pricing problem. Marginal cost pricing implies prices should be made equal to marginal costs even where marginal cost is less than average cost with government subsidies used to maintain production. Problems with this criterion are, first, it promotes the growth of state enterprises over the private sector. Second, the rule tends to redistribute income toward consumers of subsidized products. Third, there is a resource misallocation which results from taxation necessitated by the subsidies. The author auggests the need to examine the total effect of a policy proposal. To stress the role of costs in price determination, he considers a government regulatory decision. The cost to the common carrier of providing services to private industry are the additional costs of the service compared with the total cost incurred if no service was provided. Of importance for decision-making are the present and future additional costs and not the historical ones. The regulated firm in a competitive situation must respond on the basis of the alternative cost to achieve economic efficiency and survival. This discussion should prove relevant to water area studies concerned with pricing decisions. (Siegenthaler-Rutgers)
W71-00781

ESTIMATION OF FIRST ROUND AND SELECTED SUBSEQUENT INCOME EFFECTS OF WATER RESOURCES INVESTMENT,
Chicago Univ., Ill. Dept. of Economics.
George S. Tolley, V. S. Hastings, Adnan Z. Daghestani, Robert Rugg, and Shaul Ben-David.
Available from NTIS as AD-708 925, $3.00 in paper copy, $0.95 in microfiche. Final Report, February 1970, 256 p. Army Engineers Institute for Water Resources, IWR 70-1. Contract DA-49-129-CIVENG-65-11.
Identifiers: *Economics, Water supplies, *Natural resources, Management planning, Recreation, Employment, Statistical data, Wages, Abundance, Regression analysis, Mathematical models, Population, Investments, Benefit cost analysis, National income, Population migrations.

The publication presents research leading to a methodology for estimating the first-round local ef-

fects related to the change in the availability of water for supply purposes or recreation. It develops estimates of demand for reservoir recreation, and estimates the change in structural unemployment resulting from changes in output. It evaluates the differences in regional multiplier values, proposes a refinement in regional multiplier estimates, and integrates the various research papers, presenting a case for the selected strategy for estimating those national income benefits to water resource development in excess of direct output valued in terms of the users 'willingness to pay.'
W71-00799

6D. Water Demand

DEMAND FOR WATER UNDER DYNAMIC CONDITIONS,
John Hopkins Univ., Baltimore, Md.
Steve H. Hanke.
Water Resources Research Vol 6, No 5, p 1253-1261, October 1970.

Descriptors: *Water demand, *Prices, *Water rates, *Measurement, *Instrumentation, Time series, Economic evaluation, Equilibrium, Forecasting, Domestic water, Sprinkling, Regression analysis, Model study, Planning.
Identifiers: *Metering, *Dynamic analysis, *Boulder Colorado.

This paper attempts to estimate the demand for residential water in Boulder, Colorado, under dynamic conditions. It presents an empirical analysis of the effects of changing from a flat rate price structure to a metered one for the purpose of establishing an equilibrium in the water market through changes in demand. The study provides an empirical test to determine whether the demand curves for residential water use are negatively sloped and conform to the standard postulates of demand theory. Time series data were used and residential demand broken down into the categories of domestic and sprinkling consumption. The quantities of both types of water demanded were significantly reduced by the introduction of a commodity charge and continued to remain at this lower level. The author concludes that pricing policies must be taken into account in forecasting future water demands. (Murphy-Rutgers)
W71-00758

REGIONAL WATER PLAN, PART I.
Heart of Texas Council of Governments, Waco.

Available from the NTIS as PB 192 706, $3.00 in paper copy, $0.95 in microfiche. May 1970, 55 p.
Identifiers: *Management planning, Water supplies, *Water supplies, *Texas, Population, Volume, Terrain, Surface properties, Drainage, Statistical data, Terrain, Selection, Storage, Dams, Sources, Industries, Water use, Regional planning, Water storage, Groundwater.

The report includes the findings of the Heart of Texas Council of Governments Regional Water Plan, Part I. The plan has been undertaken to ascertain the water demands by the year 1985. Primary considerations in the plan design were that determination of total water demands, per capital consumption rates, industrial and commercial demands and the spatial distribution of water requirements across the planning area.
W71-00794

RICHMOND REGIONAL WATER PLAN. AREA WIDE PLAN FOR LONG RANGE DEVELOPMENT.
Richmond Regional Planning District Commission, Va.

Available from NTIS as PB-192 442, $3.00 in paper copy, $0.95 in microfiche. April 1970, various pagings. HUD Project Va. P-42.

Identifiers: *Urban areas, Water supplies, *Water supplies, *Management planning, Data, Volume, Sources, Civil engineering, Virginia, *Regional planning and development, Richmond, Virginia, Water consumption, Water services.

The volume consists of tabulated water demands by demand zones and other supplementary technical data pertinent to the basic report.
W71-00804

RICHMOND REGIONAL SEWERAGE PLAN. AREA WIDE PLAN FOR LONG RANGE DEVELOPMENT, TECHNICAL DATA.
Richmond Regional Planning District Commission, Va.
For primary bibliographic entry see Field 05G.
W71-00805

VERMONT SHADE ROLLER CO V BURLINGTON TRACTION CO (MEASUREMENT OF USE OF INDUSTRIAL WATER).
For primary bibliographic entry see Field 06E.
W71-00878

CONSUMPTIVE USE OF IRRIGATION WATER IN WYOMING,
Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 03F.
W71-00901

QUANTITATIVE ANALYSIS OF INDUSTRIAL WATER-USE PATTERNS IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Water Resources Research Inst.
Ausberto Guilbe.
Available from NTIS as PB-195 639, $3.00 in paper copy, $0.95 in Microfiche. University of Puerto Rico Water Resources Research Institute Report, June 1970. 58 p, 15 fig, 38 tab, 7 ref, append. OWRR Project A-003-PR (3).

Descriptors: *Water utilization, *Waste water disposal, *Waste treatment, *Industrial water, Puerto Rico, Water reuse, Water quality, Water treatment, Water sources, Surveys.
Identifiers: Industrial water use (Puerto Rico).

Water-use characteristics of a sample of factories were studied in several parts of Puerto Rico. The factories belong to the metal, chemical-petrochemical, pulp-paper, and food processing classifications. A questionnaire was employed for this purpose. The two main sources of water intake reported were public utilities and deep wells. Only 32% of the plants reported treating intake water. Cooling, production and distribution of heat and power, and incorporation into product ranked highest of all water uses. Only 20% of the factories reported using evaporative type air cooling systems. Forty one percent reported practicing water reuse. The municipal sewer system, underground disposals, and the ocean ranked highest of all waste water receiving bodies. Sedimentation and neutralization were the most frequently reported waste water treatments. (Knapp-USGS)
W71-00902

6E. Water Law and Institutions

ERIE RR V STATE TAX COMM'N (TAXATION OF RAILROAD BRIDGE OVER A NAVIGABLE RIVER).

293 NY 900, 60 NE2d 31 (1944).

Descriptors: *New York, *Railroads, *Bridges, *Assessments, Canals, Navigation, Taxes, Dams, Navigable rivers, Transportation, Navigable waters, Non-navigable waters, Judicial decisions, Legal aspects, Evaluation, State governments, Legislation.

Plaintiff railroad company sought judicial review of franchise assessments levied by defendant state tax commission on a railroad bridge over a river. Plaintiff contended that the river was not navigable at the crossing point and therefore the bridge was not subject to the tax. Defendant argued that the river was navigable since it had been dammed and canalized, was referred to in the local city directory as navigable, and was designated a public highway by several state statutes. A judgment for defendant was affirmed per curiam. (Liptak-Florida)
W71-00602

COMM'R OF PUBLIC WORKS V CITIES SERVICE OIL CO (REVOCATION OF PERMIT TO MAINTAIN PIER IN TIDAL WATERS).
32 NE2d 277-286 (Mass 1941).

Descriptors: *Massachusetts, *Piers, *Tidal waters, *Regulation, Judicial decisions, Legal aspects, Riparian rights, Access routes, Right-of-way, Permits, Legislation, State governments, Administrative agencies, Navigable waters, Docks, Coastal structures, Riparian waters, Usufructuary right, Prescriptive rights, Riparian land, Oil industry, Supervisory control (Power).

Plaintiff commissioner of public works sued defendant oil company to compel removal of a pier and dolphins that had been erected by defendant over state tidewater under license from the public works department. Plaintiff contended that both the law and the license provided that the right to maintain the structures over state waters was revocable and, upon notice, the structures had to be removed. Defendant argued that the license law exempted valuable structures from the revocation provisions and that the revocation of the permit would impair its riparian right of access to navigable water. Affirming a judgment for plaintiff, the court held that defendant had applied for, and received, a temporary license and could not complain of terms it agreed to upon acceptance of the license. The court also noted that the exemption of valuable structures from the automatic expiration provisions did not extend to plaintiff's discretionary power to revoke. The court did not reach defendant's last contention since the structures were not erected pursuant to defendant's riparian rights but solely on the authority of the license law. (Liptak-Florida)
W71-00603

NORTHERN NEW YORK POWER CORP V STATE (RIPARIAN RIGHT TO SURPLUS WATER FROM LOCK AND CANAL OPERATION).
293 NY 756, 57 NE2d 837 (1944).

Descriptors: *Water rights, *New York, *Riparian rights, *Appropriation, Canals, Locks, Dams, Riparian land, Water supply, Alteration of flow, Riparian waters, Compensation, Damages, Value, State governments, Legal aspects, Judicial decisions, Preferences (Water rights), Inland waterways, Navigation, Gates.

Plaintiff power company brought action against defendant State of New York to recover for water rights appropriated for the construction and maintenance of certain dams and locks. Plaintiff contended that as a riparian owner it was entitled to all surplus water in excess of that required by defendant for the maintenance of the canal and for proper navigation. Defendant argued, as had been established by earlier decision, that plaintiff's water rights were limited to the amount of water flowing through certain openings in one of the dams. A judgment for plaintiff was affirmed per curiam. (Liptak-Florida)
W71-00604

BERT V CITY OF ALLIANCE (CITY'S LIABILITY FOR POLLUTION OF RIVER BY SEWAGE TREATMENT PLANT).
32 NE2d 49-51 (Ohio Ct App 1936).

Descriptors: *Ohio, *Water pollution, *Odor, *Sewage treatment, Pollution abatement, Riparian rights, Riparian land, Water pollution effects, Municipal wastes, Sewage, Sewage effluents, Sewage sludge, Sludge disposal, Waste disposal, Rivers, Waste water (Pollution), Cities, Local governments, Judicial decision, Legal aspects, Adjudication procedure, Remedies.

Plaintiff landowner sought damages and an injunction to restrain the emission of noxious odors from defendant's sewage treatment plant and the discharge of sludge from such plant into a river which ran through plaintiff's farm. Plaintiff contended that defendant's activity constituted a nuisance and injured his enjoyment of his property. Defendant argued that the river was polluted before it reached the sewage treatment plant and that there were no odors emanating from the plant. Affirming the judgment for defendant, the court held that the conflicting evidence of the existence and origin of any pollution and odors was properly submitted to the jury, and the evidence fully supported their finding for defendant. (Liptak-Florida)
W71-00609

SMITH V WATERWORKS BD (CONSTITUTIONALITY OF WATER WORKS INDEBTEDNESS).
175 So 380-383 (Ala 1937).

Descriptors: *Alabama, *Waterworks, *Debt, *Cities, Water supply, Public health, Community development, Cost repayment, Loans, Interest, Public utilities, Judicial decisions, Legal aspects, Municipal water, Water costs, Water conveyance, Water delivery, Financing, Legislation.
Identifiers: *Constitutionality.

Plaintiff taxpayer sought to enjoin incorporation of defendant city's waterworks. The city planned to incorporate its waterworks and to issue bonds to build waterworks facilities. The bonds would be secured by mortgaging and pledging future earnings from such facilities. An Alabama general act authorized this type of financing without a general election for taxpayer approval, since tax revenues would not be utilized to pay the debt. The act declared that a debt thus created would not be a municipal debt. Plaintiff contended that the city would be liable for the debt thus established without taxpayer approval, in violation of the Alabama constitution. In holding for defendant, the court reasoned that a mortgage or pledge from an already-existing, city-owned facility would be a prohibited municipal debt if given without voter approval, but a pledge or mortgage upon facilities to be constructed with the borrowed funds would be solely a debt of the waterworks board. (Hart-Florida)
W71-00610

STATE V BD OF COMM'RS OF CADDO LEVEE DISTRICT (OWNERSHIP OF BEDS OF NON-NAVIGABLE WATERS).

188 La 1, 175 So 678-688 (1937).

Descriptors: *Ownership of beds, *Bodies of water, *Louisiana, *Administrative agencies, Levees, Management, Judicial decisions, Legal aspects, Regulation, Administration, Legislation, Projects, Navigable waters, Lakes, Bayous, Streams, State governments, Prior appropriation, Water resources development, Water allocation (Policy), Land tenure, Non-navigable waters.

Louisiana state officials certified and transferred the bed of a non-navigable portion of a bayou to defendant levee board pursuant to an act which granted lands within the levee district to the levee boards. Prior to the certification and transfer, a Louisiana statute was passed which declared the state to be the owner of waters and beds of all bayous, lagoons, lakes, rivers and bays except those under direct private ownership and those transferred as directed by law to a levee board. Plaintiff state and defendant both claimed ownership of the bed of the bayou. The Louisiana supreme court held for plaintiff, concluding that the grant to defendant was repealed by the statute declaring the state as owner of waters and beds of streams such as the land in question. The court determined that the exception clause of the repealing statute referred to private owners of waters and beds and not to the several levee boards whose rights, privileges, and obligations are at all times under legislative control. (Powell-Florida)
W71-00611

HOWELL V CITY OF DOTHAN (ABATEMENT OF NUISANCE CAUSED BY MUNICIPAL WASTES).
174 Sc 624-630 (Ala 1937).

Descriptors: *Alabama, *Pollution abatement, *Sewage, *Water pollution, Cities, Judicial decisions, Legal aspects, Municipal wastes, Riparian rights, Watercourses (Legal), Water rights, Streams, Odor, Damages, Local governments, Sewage disposal, Remedies.

Plaintiff landowner brought action against defendant municipality to abate a nuisance caused by the overflow, diversion and discharge of sewage into a creek adjoining plaintiff's land. Plaintiff also sought damages for the loss of stock due to pollution of the creek and for permanent injuries to his land. The Supreme Court of Alabama affirmed the lower court decree awarding an injunction to plaintiff but denying recovery of damages. The court held that the plaintiff landowner was not entitled to a judgment against defendant for injuries and damage to his land because the evidence was not sufficient as to time of destruction of the timber and of deterioration of the cultivatable land so as to warrant recovery. (Powell-Florida)
W71-00638

WHITE V HUGHES (RELATIVE RIGHTS OF MOTORISTS AND BATHERS TO UTILIZE BEACH).
190 So 446-454 (Fla 1939).

Descriptors: *Florida, *Beaches, *Swimming, *Scenic highways, Atlantic Ocean, Highways, Legal aspects, Judicial decisions, Adjudication procedure, Safety, Scenery, Accidents, Hazards, Legislation, Riparian rights, Competing uses, Relative rights, Riparian land, High water mark, Low water mark, State jurisdiction, Boundaries (Property), Access routes, Public rights.

Plaintiff bather sought damages from defendant motorist for injuries sustained when defendant's vehicle struck him while plaintiff was sitting on the beach. The court held that the right of bathers to use the beach was superior to that of motorists and ruled that: (1) a riparian owner has common rights of access to the adjacent waters in common with the general public, subject to lawful state and federal legislation; (2) the beach of the Atlantic Ocean between high and low water mark is state property, held in trust for all the people; and (3) the state, in the interest of the general welfare, had lawfully designated the Atlantic beach as a public highway, but the authorization to use the beach as a highway was subject to its long-established reasonable use for bathing, recreation and navigation. (Hart-Florida)
W71-00640

MCCLUSKEY V MERAUX AND NUNEZ, INC (NAVIGABILITY OF STREAM).
186 So 117-121 (La 1939).

Descriptors: *Louisiana, *Navigable rivers, *Ownership of beds, *Prescriptive rights, Boundaries (Property), River beds, Non-navigable waters, Legal aspects, Judicial decisions, Adjudication procedure, Reservation doctrine, Streambeds, Streams, Beds under water, Boundary disputes, Navigable waters, Land tenure.

Plaintiff landowner brought action to quiet title to property claimed by defendant by prescription. The land in question was separated from defendant's land by a stream. Plaintiff contended that since the stream was navigable, the title to its bed was in the state, and therefore defendant's prescription could not have included the property in question. Defendant contended that the stream was nonnavigable, and consequently his prescriptive title extended across the stream to the land in question. The court found that the burden of proving navigability or non-navigability rested upon the party to whose advantage it would be to establish the fact. The court stated that: (1) where a stream was navigable when a state was admitted to the Union, the streambed became state property by virtue of its sovereignty; and (2) a stream is navigable in law when navigable in fact. Both parties had presented directly contradictory evidence on the width and depth of the stream as of the data Louisiana was admitted to the Union. Since defendant's evidence of non-navigability was strongly controverted, the court held that defendant had not acquired prescriptive rights in the property. (Hart-Florida)
W71-00641

CITY OF MERIDIAN V PEAVY (OBSTRUCTION OF FLOW IN CULVERT).
194 So 595-596 (Miss 1940).

Descriptors: *Mississippi, *Culverts, *Damages, *Adjudication procedure, Condemnation, Sewers, Storm runoff, Excess water (Soils), Floodwater, Rainfall disposition, Rainfall intensity, Water injury, Rainfall-runoff relationships, Flood damage, Overflow, Storm drains, Judicial decisions, Legal aspects, Cities, Impoundments, Obstruction to flow.

Plaintiff landowner sued defendant city for damages to realty and personality caused by water backing up over a plugged culvert. Defendant had installed a sewer pipe within the culvert, causing it to clog with sand and debris and impounding water which overflowed plaintiff's property. The overflowing water caused the pillars in plaintiff's residence to sink and destroyed his garden five times in one season. All contentions and evidence at the trial were based upon defendant's negligence in maintaining the culvert, but plaintiff obtained a jury instruction for the jury to find for plaintiff unless unprecedented rainfall caused the damage. The court found that this instruction pre-empted the issue of negligence, so that the jury's findings on the uncontroverted issue of rainfall would control the verdict. Plaintiff sought to sustain the instruction under a constitutional provision which entitled him to damages for inverse condemnation. In holding that the jury instruction was erroneous, the court reasoned that the defenses available for a condemnation action were entirely different from those for negligence, and held that plaintiff could not recover under a theory neither raised in the pleadings nor proved at the trial. (Hart-Florida)
W71-00663

RISING WATER VALUES THAT RESULT FROM INCREASED MOBILITY,
Utah State Univ., Logan. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 03F.
W71-00684

CITY OF LAKELAND V DOUGLASS (MUNICIPALITY'S POLLUTION OF LAKE AS NUISANCE).

197 So 467-470 (Fla 1940).

Descriptors: *Florida, *Water pollution, *Damages, *Municipal wastes, Adjudication procedure, Public health, Sewers, Sewage, Sewage disposal, Water pollution sources, Mosquitoes, Minnows, Water pollution effects, Pollutants, Fish-kill, Odor, Carriers, Intermediate hosts, Judicial decisions, Legal aspects, Cities, Local govern-

ments, Remedies, Lakes, Riparian rights, Riparian land.
Identifiers: *Nuisance.

Plaintiff littoral landowner brought action against defendant city for damages from pollution. Defendant turned raw city sewage into a canal which ran into a lake upon which plaintiff's property bordered. The canal and lake were severely polluted, giving off noxious odors, destroying mosquito-larvae eating minnows, and contaminating the lake. Plaintiff claimed loss of the use and enjoyment of his property and injury from malaria caused by the proliferation of mosquitoes. Defendant appealed the trial court's judgment for plaintiff. In affirming, the court found that the pollution was a nuisance for which the municipality was liable in damages. However, the court declared that plaintiff's claimed injury from loss of employment from malaria was too speculative to be allowed as a basis for damages from defendant. (Hart-Florida)
W71-00713

THE PAN-AM (OIL POLLUTION BY OIL TANKER IN COASTAL WATERS).

148 F2d 925-927 (3rd Cir 1945).

Descriptors: *Water pollution, *Legislation, *Ships, *Damages, Water pollution sources, Pollutants, Oil, Navigable waters, Admiralty, Waves (Water), Ocean waves, Winds, Weather, Wind velocity, Judicial decisions, Legal aspects, Seepage, Oily water.
Identifiers: *Oil Pollution Act.

Plaintiff United States filed a libel against defendant oil tanker for discharge of oil in violation of the Oil Pollution Act. The vessel had discharged oil into the coastal navigable waters of the United States. Defendant answered that the vessel had encountered strong winds which strained the vessel and caused the seepage, and therefore the oil seepage was unavoidable and caused by an emergency. The court found that no willingness or intent to discharge oil, nor overt act were required to impose liability under the Act; however, the Act was found to excuse liability if seepage was a result of an emergency or unavoidable accident, collision or stranding. The evidence revealed that the weather and sea conditions encountered were not severe, and the vessel had received certificates of seaworthiness just prior to the voyage in question. Holding that the evidence did not support a finding of unavoidable accident under the Act, the court affirmed the judgment for plaintiff. (Hart-Florida)
W71-00716

WISCONSIN PUB SERV CORP V FEDERAL POWER COMM'N (HYDROELECTRIC PROJECT LICENSING).

147 F2d 743-749 (7th Cir 1945).

Descriptors: *Wisconsin, *Navigable rivers, *Hydroelectric project licensing, *Federal Power Act, Hydroelectric power, Hydroelectric plants, Navigation, Non-navigable waters, Lumbering, Interstate rivers, Judicial decisions, Legal aspects, Dams, Rivers, River regulation, Legislation, Administrative agencies, Administrative decisions, Supervisory control (Power), Permits.

Plaintiff corporation brought action against defendant commission to set aside defendant's order for plaintiff to apply for a license under the Federal Power Act before operating a hydroelectric project on the Wisconsin River. Defendant contended that the Wisconsin River was navigable, and therefore plaintiff was required to obtain a license to operate the project. Plaintiff contended the river was non-navigable because of obstruction. Defendant proved that the river was extensively used for transportation of logs in interstate commerce from 1858 to 1907. Plaintiff contended that use for logging and rafting was insufficient for navigability. The court defined navigability in law as navigability in fact, noting that a river is navigable in fact when it is susceptible to use as a highway for commerce. The court stated further that: (1) log floating in continuous movement between states is interstate commerce; (2) absence of use over a long period because of changed conditions does not affect navigability; (3) once navigable, a waterway remains so; and (4) the ultimate finding of navigability is a factual question. On this basis the court concluded that the Wisconsin River was navigable. Plaintiff's further assertions that the logging operations were intrastate and that defendant's order ultra vires were rejected, and the court affirmed defendant's order. (Hart-Florida)
W71-00717

PENNSYLVANIA WATER AND POWER CO. V FEDERAL POWER COMM'N (HYDROLECTRIC PROJECT LICENSING).
123 F2d 155-163 (DC Cir 1941).

Descriptors: *Pennsylvania, *Navigable rivers, *Hydroelectric project licensing, *Federal Power Act, Hydroelectric power, Hydroelectric plants, Navigation, Non-navigable waters, Interstate rivers, Judicial decisions, Legal aspects, Dams, Rivers, River regulation, Legislation, Administrative agencies, Administrative decisions, Regulation, Permits, Supervisory control (Power).

Plaintiff power company brought action to set aside defendant commission's order to apply for a license to operate its hydroelectric project on the Susquehanna River. Plaintiff asserted that the river was non-navigable, but further asserted that if it was navigable, the dam was still lawful since it was erected with congressional consent prior to enactment of the Federal Power Act, which had only prospective application. In holding the Susquehanna to be navigable, the court stated that a river is navigable in law when it is navigable in fact, and when a river, with reasonable expenditure, may be made navigable, then it is navigable in fact. Finding that reasonable efforts would render the Susquehanna navigable, the court affirmed defendant's order. The court rejected plaintiff's contention that the dam was lawful notwithstanding navigability, noting that a congressional grant was not binding upon future Congresses, and that the language of the Federal Power Act indicated an intent to give it retrospective application. (Hart-Florida)
W71-00718

GOUAX V BOVAY (PAYMENT OF TOLL BY UNITED STATES FOR USE OF INTERSTATE TOLL BRIDGE).
105 F2d 256-259 (5th Cir 1939).

Descriptors: *Mississippi, *Louisiana, *Bridges, *Payment, Bridge construction, Cost sharing, Legislation, Rivers, Mississippi River, Navigable rivers, Highways, Federal government, United States, Legal aspects, Judicial decisions, Adminstrative agencies, Interstate.
Identifiers: *Constitutionality.

Plaintiff army officer sought repayment of tolls paid for movement of federal troops and vehicles across a Mississippi River bridge owned by defendant bridge company. Plaintiff contended that under the Bridge Act, no tolls were payable. Defendant asserted that the Bridge Act and cngresssional authorization expressly permitted tolls. The court noted that since the bridge was interstate, Congress might regulate the tolls. The erection of any bridge over navigable waters not lying wholly within one state requires congressional consent. However, the court found that where Congress had given no special aid to the enterprise, free use by the United States would not be assumed. After pointing out that where the United States had assisted construction of such bridges, immunity from tolls had often been expressly stipulated, the court concluded that immunity from toll for plaintiff would amount to taking property without conpensation, and affirmed the lower court's decision for defendant. (Hart-Florida)
W71-00725

A MODEL OF OPTIMUM WATER ALLOCATION UNDER IOWA'S PERMIT SYSTEM,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 06A.
W71-00730

THE NORTHEAST OHIO WATER DEVELOPMENT PLAN PROGRAM FOR ACTION,
Ohio Dept. of Natural Resources, Columbus; and Stanley Consultant, Cleveland, Ohio.
For primary bibliographic entry see Field 06B.
W71-00740

HEGGLUND V UNITED STATES (CRIMINAL PROSECUTION FOR DISCHARGE OF OIL INTO NAVIGABLE WATERS).

100 F2d 68-71 (5th Cir 1938).

Descriptors: *Louisiana, *United States, *Oily water, *Water pollution, Path of pollutants, Pollution abatement, Pollutants, Water pollution sources, Oil wastes, Ships, Navigable waters, Leakage, Legislation, Remedies, Judicial decisions, Legal aspects, Oil, Oil industry.

Defendant was convicted of violating a federal statute which forbade the discharge of oil by a ship into coastal navigable waters of the United States. On appeal, he argued that the statute contemplated only an intentional discharge and that his action was unintentional and came within the statutory exception covering such discharges in cases of unavoidable accidents. The United States Circuit Court of Appeals, Fifth Circuit, ruled that the act was designed to cover unintentional as well as intentional discharge and that the fact that defendant knew his ship to be leaky was sufficient to take the case out of the unavoidable accident exception of the statute. The conviction was affirmed. (Barker-Florida)
W71-00741

LAKEWOOD SS CO V SUPERIOR WATER, LIGHT AND POWER CO (DAMAGE TO UNDERWATER WATER MAIN).
88 F2d 895-899 (7th Cir 1937).

Descriptors: *Wisconsin, *United States, *Damages, *Conduits, Metal pipes, Pipes, Water conveyance, Navigable waters, Bays, Legislation, Governments, Ships, Anchors, Pumping, Pumps, Pumping plants, Remedies, Judicial decisions, Legal aspects, Piping systems (Mechanical), Navigation.

Plaintiff operated a water main beneath the waters of a bay between Wisconsin and Minnesota. Defendant steamship company's ship dragged its anchor across the main, thus damaging the pipe. Plaintiff brought suit to recover the damages, contending that he was operating the water main properly, pursuant to federal statutes. Defendant argued that plaintiff had failed to obtain proper permission for his operations and that such activity by plaintiff was subject to the paramount right to full navigation in the bay. Affirming the trial court's ruling for plaintiff, the United States Circuit Court of Appeals, Seventh Circuit, ruled that plaintiff had secured sufficient authority from the government and that the water main was not an obstruction to navigation. (Barker-Florida)
W71-00753

IN RE WATERWAY TO UPLANDS (CONDEMNATION AWARD).
259 App Div 747, 18 NYS2d 721-723 (1940).

Descriptors: *New York, *United States, *Condemnation value, *Eminent domain, Condemnation, Compensation, Governments, Bulkhead line, Streams, Judicial decisions, Legal aspects, Property values.

In a memorandum decision wherein the facts were not stated, the Supreme Court of New York, Appellate Division, ruled that in a condemnation proceeding, the owner of the condemned property was entitled to an award representing the difference between the value of bulkhead premises before the taking and the value remaining after the taking. The court also ruled that the claimant could not recover for loss of access due to the federal government's failure to remove a damage parcel since it could be removed at any time and meanwhile was available for claimant's use without expense. (Barker-Florida)
W71-00754

JOHNSON V DRAKE (LIABILITY FOR FLOOD DAMAGE CAUSED BY BACKWATER).
142 SE 552-553 (Ga 1928).

Descriptors: *Georgia, *Dams, *Streams, *Flooding, Flood damage, Water injury, Backwater, Riparian land, Riparian waters, Riparian rights, Local governments, Cities, Highways, Public benefits, Legal aspects, Judicial decisions, Adjudication procedure, Cultivated lands.
Identifiers: *Dedications.

Plaintiff riparian owner sued to enjoin defendant riparian owner from maintaining a dam across a stream. Plaintiff also sought to recover damages to her crops resulting from flooding caused by the dam. Plaintiff contended that the dam was a continuing nuisance and that the flooding was a continuing trespass. Defendant contended that the dam was dedicated to public use, having been built originally by the city, and that the common grantor of plaintiff's and defendant's property had released defendant's predecessor from all liability in connection with the dam. The court found no error in the admission of defendant's evidence concerning the dedication and earlier release. The directed verdict for defendant was affirmed. (Liptak-Florida)
W71-00756

SOUTHERN RY V NEAL (RAILROAD'S LIABILITY FOR FLOODING CAUSED BY INADEQUATE CULVERT).

135 SE 703-706 (Va 1926).

Descriptors: *Virginia, *Historic flood, *Obstruction to flow, *Culverts, Floods, Flood damage, Maximum probable flood, Natural flow doctrine, Railroads, Judicial decisions, Legal aspects, Damages, Streams, Streamflow, Mills, Bridges, Bridge construction, Bridge design, Backwater.

Plaintiff mill owner brought an action against defendant railroad to recover for flood damage to plaintiff's mill. The damage was caused when defendant's culvert over a stream backed up flood waters onto plaintiff's land. Plaintiff contended that defendant was negligent in constructing a culvert insufficient to pass the natural flow of the stream. Defendant contended that the damage was caused by an unprecedented flood which defendant was under no duty to anticipate when designing its culvert. The court noted that, if similar floods had previously occurred in the area, defendant should anticipate such occasional unusual flood. A lower court judgment for plaintiff was affirmed. (Liptak-Florida)
W71-00760

OPTIMALITY, 'PUBLIC' GOODS, AND LOCAL GOVERNMENTS: A GENERAL THEORETICAL ANALYSIS,
Northwestern Univ., Evanston, Ill.
For primary bibliographic entry see Field 06A.
W71-00770

CROMARTIE V STONE (LIABILITY FOR DEATH CAUSED BY IMPROPER MOORING IN NAVIGABLE RIVER).

194 NC 663, 140 SE 612-616 (1927).

Descriptors: *North Carolina, *Navigable rivers, *Boats, *Accidents, State jurisdiction, Federal jurisdiction, Dams, Rivers, Navigable waters, Locks, Channels, Admiralty, Damages, Legal aspects, Judicial decisions.

Plaintiff widow brought action against defendant barge company for the wrongful death of her husband. Plaintiff contended that defendant was negligent in mooring its boat and two barges in the calm part of a navigable river, thereby causing the husband's raft to veer into the swift part of the channel and go over a dam. Defendant contended that it was not negligent, that plaintiff's husband was contributorily negligent, and that the state court had no jurisdiction over an admiralty matter. In affirming a judgment for plaintiff, the court noted that navigable rivers were public highways which everyone had a right to use. Defendant was under a duty to use reasonable care to avoid injury to other boats and river craft. Moreover, a state may properly grant a remedy recognized by both common law and admiralty law. (Liptak-Florida)
W71-00772

PURSEL V POLSTER (LOWER RIPARIAN OWNER IS ESTOPPED FROM DENYING THE RIGHT TO DRAW WATER TO SUPPER RIPARIAN OWNER WHO HAD OBTAINED PREVIOUS PERMISSION FROM LOWER OWNER).
169 A 339-340 (NJ 1933).

Descriptors: *New Jersey, *Riparian rights, *Domestic water, *Water demand, Consumptive uses, Legal aspects, Judicial decisions, Streams, Springs, Competing uses, Relative rights, Prior appropriation, Water utilization, Diversion, Beneficial use, Potable water, Water allocation (Policy).

Plaintiff reparian owner sought to enjoin defendant landowner from continuing to draw water from plaintiff's stream and spring. While admitting that she had previously consented to defendant's use of some of the water, plaintiff contended that defendant was drawing water to such an extent that plaintiff's supply was severly diminished. Defendant contended that having acquired permission from plaintiff she was entitled to draw a reasonable amount as long as she did not interfere with plaintiff's supply. The New Jersey court held that plaintiff was estopped from denying defendant the right to take a resonable amount of water as long as plaintiff's supply was not unreasonably impaired. (Quesada-Florida)
W71-00792

NAPORRA V WECKWERTH (ACQUSITION OF PRESCRIPTIVE RIGHT TO DRAIN SURFACE WATER).
For primary bibliographic entry see Field 04A.
W71-00808

LAND AGAINST THE SEA.
Army Coastal Engineering Research Center, Washington, D.C.
For primary bibliographic entry see Field 02L.
W71-00824

CHURCHILL V HARRIS (RIGHT TO ENTER LAND TO EXERCISE WATER RIGHTS).

257 Mass 499, 154 NE 87-88 (1926).

Descriptors: *Massachusetts, *Water rights, *Easments, *Right-of-way, Streams, Streamflow, Riparian land, Riparian waters, Riparian rights, Reasonable use, Judicial decisions, Legal aspects, Water law, Competing uses, Land tenure, Relative rights, Water supply, Real property.
Identifiers: Injunction (Restraining).

Plaintiff landowner sold land to defendant landowner, but reserved the right to use one half of a stream on the defendant's land for the use of plaintiff's adjoining property. Plaintiff sued to restrain defendant from interfering with the enjoyment of the reserved water rights. Defendant had refused to allow plaintiff onto the land to connect the pipes leading to plaintiff's land. Plaintiff contended that the reservation of the water rights necessarily implied the right to go onto the defendant's land to exercise those rights. Defendant contended that the reservation created no easement and that plaintiff should pay for such an easement. The court held that plaintiff not only had a valid appurtenant easement but also was a part owner of the land from which the spring flowed. The judgnent sustaining defendant's demmurer was reversed. (Liptak-Florida)
W71-00871

THURSTON V CARTER (BREACH OF CONTRACT TO KEEP TITLE DITCH OPEN).

155 NE 834-835 (Ind 1927).

Descriptors: *Indiana, *Tile drainage, *Obstruction to flow, *Claims (Contracts), Contracts, Ditches, Drains, Tiles, Drainage, Surface drainage, Surface water, Water rights, Legal aspects, Judicial decisions, Drainage effects, Damages, Drainage systems, Easements.

Plaintiff and defendant owned adjoining farms which were drained by a tile ditch. Plaintiff had agreed to rebuild the ditch if defendant would keep his portion of the ditch open and unobstructed. Plaintiff brought action against defendant for damages resulting from defendant's failure to keep the ditch open. Plaintiff contended that there was a valid, binding contract requiring defendant to keep the ditch open. Defendant argued that the contract simply gave plaintiff an easement across defendant's land and that it was plaintiff's duty to repair the ditch. Affirming a judgment for plaintiff, the court held that the contract was valid and that defendant, by refusing to perform, could not shift the duty of keeping the ditch open to plaintiff. (Liptak-Florida)
W71-00873

CHELTENHAM AND ABINGTON SEWERAGE CO V PUBLIC SERVICE COMM'N (DEDICATION OF SEWERAGE SYSTEM).
162 A 469-473 (Pa 1932).

Descriptors: *Pennsylvania, *Sewers, *Administrative agencies, *Rates, Clay pipes, Disposal, Drainage systems, Sewage disposal, Storm drains, Easements, Urbanization, Land tenure, State governments, Drainage, Water conveyance, Administrative decisions, Drainage programs.

Plaintiff sewerage company appealed an order of defendant public service commission abolishing plaintiff's charges for sewerage systems in two townships. The sewerage systems of the townships were installed by a promoter along with surface drainage improvements. The promoter formed plaintiff corporation, but did not convey his rights in the systems to plaintiff until after the sale of a number of lots in certain subdividions. The promoter's conveyances to the lot owners did not reserve any rights to the sewerage system. No charges for the storm sewers had been made for 30 years. Defendant contended that these circumstances proclaimed the promoter's intent to dedicate the sewerage system to the public, and hence plaintiff did not own the system. Sustaining this contention, the court noted that the residents had a drainage easement wherever the promoter had installed drains in natural watercourses and held that plaintiff could not extract charges for the system. Plaintiff further contended that one of its employees cleaned the system after heavy rains three or four times per year, but the court held that this service did not justify compensation. Defendant's order was affirmed. (Hart-Florida)
W71-00874

WEISBERGER V MAURER (DISCHARGE OF SURFACE WATER ONTO ADJOINING LAND).
153 A 626-628 (NJ 1930).

Descriptors: *New Jersey, *Surface waters, *Drainage, *Discharge (Water), Adjudication procedure, Judicial decisions, Legal aspects, Pipes, Drainage systems, Discharge lines, Surface runoff, Riddance (Legal aspects), Repulsion (Legal aspects), Drainage water, Relative rights.

Plaintiff landowner sued defendant landowner for damages which resulted from the collection and discharge of surface water onto plaintiff's land. Defendant moved to strike the complaint. The court denied the motion, holding that defendant had no right to collect surface water and discharge it through a pipe onto plaintiff's land. (Hart-Florida)
W71-00875

VERMONT SHADE ROLLER CO V BURLINGTON TRACTION CO (MEASUREMENT OF USE OF INDUSTRIAL WATER).
153 A 563-572 (Vt 1931).

Descriptors: *Vermont, *Adjudication procedure, *Industrial use (Water), *Contracts, Claims (Contracts), Supply contracts, Engineers, Estimates, Contract administration, Performance, Specifications, Flumes, Diversion, Structures, Sluices, Water conveyance, Water measurement, Flow measurement, Current meters.

Plaintiff factory owner brought action against defendant water power company to determine the amount of water plaintiff was permitted to use under an agreement entered into between defendant and plaintiff's predecessor. Plaintiff contended that the previous agreement permitted the water used to be measured by the amount of water which would flow through a certain opening, such opening having rounded edges. Defendant asserted that the water used should be measured by the amount of water which would flow through such opening with square edges. Finding that the testimony presented was insufficient to support either contention, the court remanded the case for further testimony to determine which opening was contemplated by the original parties to the agreement. (Hart-Florida)
W71-00878

FAIRLAWN MANOR HOMES CO V WILKENS (PRESCRIPTIVE RIGHT TO MAINTAIN DAM).
152 A 470-471 (NJ 1930).

Descriptors: *New Jersey, *River, *Dams, *Prescriptive rights, Mills, Islands, Judicial decisions, Legal aspects, Dam construction, Obstruction to flow, Water supply, Relative rights, Alteration of flow.

Plaintiff island landowner sought a declaratory judgment determing the right of defendant dam owner to maintain a dam on the river in which plaintiff's island was located. Plaintiff contended that the dam was an illegal obstruction which caused the river to flow on only one side of his island. Defendant claimed a prescriptive right to maintain the dam. The court found that the evidence demonstrated that defendant and his predecessors had maintained the dam at the same height for more than the prescriptive period of 20 years. The court held that defendant had acquired a prescriptive right to maintain the dam and dismissed plaintiff's petition. (Hart-Florida)
W71-00891

YORK V GOLDER (EXISTENCE OF A DRAINAGE EASEMENT OF NECESSITY).
151 A 558-559 (Me 1930).

Descriptors: *Maine, *easements, *Adjudication procedure, *Ditches, Culverts, Drainage, Drainage systems, Drainage practices, Judicial decisions, Legal aspects, Relative rights.

Plaintiff landowner sued defendant landowner for damages which resulted from the obstruction of a drainage ditch on defendant's land. Plaintiff claimed an easement of necessity for drainage across defendant's lot. Defendant contended that since the ditch did not exist at the time of the trial, or exist at the time of his purchase, plaintiff had no easement. The court noted three requirements for plaintiff to have an easement of necessity: (1) there was an open drain; (2) its purpose was obvious; and (3) it was necessary for the reasonable enjoyment of plaintiff's lot. The court, reviewing the evidence, held that the jury below could properly have found that no ditch existed, and affirmed the lower court's decision for defendant. (Hart-Florida)
W71-00914

WATER POLLUTION CONTROL LEGISLATION,
Cornell Univ., Ithaca, N.Y.
For primary bibliographic entry see Field 05G.
W71-00935

GODDARD V BERLIN MILLS CO (LIABILITY FOR FLOODING CAUSED BY BACKWATER FROM DAM).

131 A 601-606 (NH 1926).

Descriptors: *New Hampshire, *Dams, *Backwater, *Flood damage, Water injury, Rivers, Navigable rivers, Riparian land, Damages, Obstruction to flow, Milldams, Water levels, Lumbering, Legal aspects, Judicial decisions, Water rights, Prescriptive rights, Adjudication procedure.

Plaintiff landowner brought action against defendant mill and dam owner to recover damages caused by backwater from the dam and from logs defendant floated and stored on the river. Plaintiff contended that closing all of defendant's flashboards had raised the water level of the river and overflowed plaintiff's land five miles upriver. Plaintiff also alleged that defendant negligently ran logs on the river, thereby damaging defendant's bank. Defendant denied the overflow, asserted a prescriptive right to maintain its dam at its present height and claimed the right to drive logs on the river. The court noted that plaintiff commenced his action before the prescriptive 20-year period had expired and that the right to drive logs on the river was conditioned on the exercise of ordinary and reasonable care. The court found that the evidence, although inconclusive, was sufficient to justify the jury's verdict and the resulting judgment for plaintiff. (Liptak-Florida)
W71-00938

ALEXANDER V WABASH RY (LIABILITY FOR OBSTRUCTION OF SURFACE RUNOFF).
38 SW2d 545-550 (Mo 1931).

Descriptors: *Missouri, *Embankments, *Surface runoff, *Obstruction to flow, Damages, Judicial decisions, Legal aspects, Crops, Railroads, Beds, Drainage, Watercourses (Legal), Ditches, Discharge (Water), Laterals, Drains, Impoundments, Conduits, Flumes, Natural flow, Alteration of flow, Impounded waters, Water injury, Flood damage, Overlying proprietors, Surface waters.

Plaintiff brought suit against defendant railroad for damages to their crops. Defendant built an embankment upon their right-of-way. Plaintiff alleged that the embankment was negligently constructed and maintained in that it provided inadequate drainage for surface waters and excessive precipitation, thereby causing an increased flow of water over plaintiff's lands. Defendant contended that their drainage facilities were adequate and that plaintiff, as lower proprietor, was occupant of the servient estate over which excess waters could flow in their natural course. The court affirmed the trial court's dismissal of the action against defendant since there was no evidence of a material fact upon which relief could have been granted. (Barnett-Florida)
W71-00965

CHICAGO, ST LOUIS AND NEW ORLEANS RR V ADKINS (LIABILITY FOR OBSTRUCTION TO FLOW DUE TO INSUFFICIENT PASSAGE IN RAILROAD EMBANKMENT).
247 Ky 241, 56 SW2d 969-972 (1933).

Descriptors: *Kentucky, *Obstruction to flow, *Flooding, *Surface drainage, Excessive precipitation, Rain, Rainfall, Drainage, Ditches, Drainage systems, Drainage water, Flow, Barriers, Damages, Flood damage, Floods, Overflow, Backwater, Flood water, Judicial decisions, Railroads, Embankments, Legal aspects.

In an action for damages, plaintiffs contended that defendant railroad company caused water to be diverted upon their lands. Plaintiffs contended that defendant negligently constructed an embankment over a drainage system ditch in that the embankment left insufficient passageways for water to flow in the ditch. Plaintiffs contended that such obstruction resulted in waters being backed up and caused to overflow, resulting in plaintiffs' lands being flooded. Defendant contended that the flooding was caused by excessive rains and that the overflow of the ditch would have occurred notwithstanding the railroad embankment. The court ruled that the issue of whether or not the embankment caused the flooding was a question for the jury. The court held that there was sufficient evidence to uphold the jury's determination that the embankment left insufficient passage for the waters and was a proximate cause of the flooding. The court also approved the trial court's instruction that the amount of damages was measured by the diminution in market value caused by the overflow. (Snow-Florida)
W71-00966

CHESAPEAKE AND O RY V STEPHENS (FLOODING CAUSED BY OBSTRUCTION OF CULVERT UNDER RAILROAD).
236 Ky 232, 32 SW2d 993-994 (1930).

Descriptors: *Kentucky, *Flood damage, *Adjudication procedure, *Compensation, Flooding, Streams, Water injury, Railroads, Obstruction to flow, Judicial decisions, Legal aspects, Real property, Property values.

Plaintiff landowner sued defendant railroad company for damages which resulted from the flooding of his property. Plaintiff contended that defendant had diverted a stream onto his land, thereby causing the flood injury. Defendant asserted that the injury was caused by a prior extraordinary flood. The court held that the decision of which act caused the injury was for the jury. The court went on to hold that $500 damages for injury to 1/2 acre of land awarded by the jury was excessive, and remanded the case for a new trial. (Hart-Florida)
W71-00967

FUNKE V ST LOUIS - SAN FRANCISCO RY (LIABILITY FOR DISCHARGE OF SURFACE WATER COLLECTED IN DITCH.
35 SW2d 977-982 (Mo 1931).

Descriptors: *Missouri, *Flood damage, *Surface drainage, *Adjudication procedure, Surface runoff, Drainage water, Overland flow, Repulsion (Legal aspects), Riddance (Legal aspects), Railroads, Legal aspects, Judicial decisions, Ditches.

Plaintiff landowner sued defendant railroad company for damages which resulted from the diversion of surface water onto plaintiff's land. Plaintiff contended that defendant had collected the water in a ditch and discharged it onto his land. Defendant contended that the lower court erred in failing to sustain his demurrer at the close of plaintiff's evidence. The court noted that any landowner could rid his property of surface water so long as it was not collected and discharged to his neighbor's injury. The court held that the lower court had properly determined that the question of whether defendant had collected the water was for the jury. The lower court's judgment for plaintiff was affirmed. (Hart-Florida)
W71-00969

CHESAPEAKE AND O RY V CLIFTON (LIABILITY FOR FLOODING CAUSED BY OBSTRUCTION OF CULVERT UNDER RAILROAD).
237 Ky, 519, 35 SW2d 884-886 (1931).

Descriptors: *Kentucky, *Flooding, *Wells, *Damages, Shallow wells, Seepage, Underseepage, Water pollution, Water pollution effects, Water pollution sources, Streams, Rivers, Streambeds, Obstruction to flow, Overflow, Flood damage, Compensation, Culverts, Judicial decisions, Legal aspects, Adjudication procedure, Railroads.

Plaintiff riparian landowner sued defendant railroad for damages which resulted from the flooding of his property. Defendant owned a right-of-way adjacent to plaintiff's land. Defendant built its railroad over a stream, placing a culvert in the streambed. The culvert clogged with debris, backing up the stream onto plaintiff's land. Plaintiff asserted the flooding injured his property and polluted his well. The court determined that the lower court had erred in allowing damages in the diminution in property value, and stated that the proper measure of damages was the diminution in rental value, since the injury was temporary. The damages for injury to the land were held to be excessive. Furthermore, since a river had recently flooded plaintiff's well, and the culvert overflow had not flooded the well but could only have caused the pollution by seepage, the evidence was held insufficient to establish that the culvert overflow was the proximate cause of plaintiff's well pollution. The case was reversed and remanded for a new trial. (Hart-Florida)
W71-00970

CAVITT V FOWLER (OWNER MAY CONSTRUCT DAM AND DITCH ON OWN LAND TO RECLAIM LAND).
285 SW 175-178 (Mo 1926).

Descriptors: *Missouri, *Land reclamation, *Land development, *Wetlands, Swamps, Drainage, Drainage practices, Land management, Dams, Dam construction, Earth dams, Diversion structures, Flow control, Flood control, Levees, Ditches, Rivers, River flow, Ponds, Channels, Conveyance structures, Water rights, Riparian rights, Water conveyance, Judicial decisions, Legal aspects.

Due to a drainage district's dredging and straightening of a river channel upstream from plaintiff's and defendant's lands, the flow of such river through defendant's land was increased. In order to protect his lowlands from overflow, defendant constructed a dam and ditch to straighten the river channel on his land. Defendant conveyed the water from the dam into a pond which emptied into the river on the downstream section of his land. Plaintiff, who owned adjoining land downstream from defendant, brought an action to recover damages which resulted to his land and crops. Plaintiff alleged that defendant wrongfully constructed and maintained the dam and ditch which caused the river flow to flood plaintiff's land. The St. Louis Court of Appeals affirmed the lower court's judgment for defendant. The court held that defendant, as owner of land made swampy by the straightened condition of the river, had the right to construct the dam or ditch and empty excess water into the river which ran through this property for purposes of reclaiming and improving his land. (Powell-Florida)
W71-00971

TIDE WATER OIL SALES CORP V SHIMELMAN (LIABILITY FOR INTERFERENCE WITH DRAINAGE OF SURFACE WATER).
158 A 229-231 (Conn 1932).

Descriptors: *Connecticut, *Surface drainage, *Surface runoff, *Obstruction to flow, Overland flow, Surface waters, Drains, Water spreading, Legal aspects, Judicial decisions, Watersheds (Divides), Natural flow, Water rights, Alteration of flow, Reasonable use, Relative rights, Watercourses (Legal).

Plaintiff and defendant owned adjoining tracts of land. Plaintiff's land was drained of surface water by means of a natural depression which ran across defendant's property. During construction of improvements upon his premises, defendant filled in the depression. This resulted in an accumulation of water on plaintiff's land which previously would have flowed through the depression. Plaintiff brought an action for damages and an injunction, alleging the right as an owner of lands from which surface water flows to relief against an obstruction of that flow. The Superior Court of Errors of Connecticut, in affirming the lower court decision held that where the drainway was not well defined, plaintiff was not entitled to prevent defendant's interference with the drainage of surface water over his land. The court reasoned that a land-owner cannot prevent interference with drainage of surface water over adjacent land unless a servitude is impressed upon the property. The court held, however, that plaintiff was entitled to enjoin defendant from discharging surface water in increased volume onto plaintiff's land. (Powell-Florida)
W71-00973

MISSOURI PAC RR V NICHOLS (RAILROAD FAILING TO PROVIDE OPENINGS IN EMBANKMENTS LIABLE FOR FLOODING LANDS).
279 SW 354-357 (Ark 1926).

Descriptors: *Arkansas, *Embankments, *Railroads, *Floods, Judicial decisions, Legal aspects, Engineering structures, Road banks, Riparian rights, Riparian land, Riparian water, Watercourses (Legal), Streams, Overflow, Overland flow, Rain water, Rain, Surface waters, Surface runoff, Excessive precipitation.

The roadbed of defendant railroad crossed a creek adjacent to plaintiff's land. The creek had been straightened and was used as a drainage ditch. A 120-foot opening in the railroad embankment through which creek waters flowed was reduced by defendant to a 4-foot concrete box. During a rainfall water backed up onto plaintiff's land, thereby destroying his crops. Plaintiff brought an action for damages, alleging that the lack of a sufficient opening in defendant's roadbed caused such damages. Defendant presented evidence indicating the sufficiency of the opening. The Supreme Court of Arkansas affirmed the trial court's judgment for plaintiff, holding that the evidence presented supported plaintiff's verdict. The court stated that if defendant failed to provide openings so as not to flood plaintiff's land either at ordinary water stage or during floods which could reasonably have been foreseen, it was liable. The court determined that defendant's duty to provide a water outlet was continuous. Also, defendant should have provided an outlet, not merely for water falling within the banks of the stream crossed, but for all water which customarily flowed into the stream from the surface of the adjacent land. (Powell-Florida)
W71-00974

LUTESVILLE SAND AND GRAVEL CO V MCLAUGHLIN (OWNERSHIP OF SANDBAR IN NAVIGABLE STREAM).
26 SW2d 892-895 (Ark 1930).

Descriptors: *Arkansas, *Navigable waters, *Ownership of beds, *Sand bars, Gravels, Damages, Remedies, Judicial decisions, Legal aspects, Tidal waters, Riparian rights, Riparian land, High water mark, Beds under water, Public rights, Permits, Federal government, Bridges, Meanders, Navigable rivers, Boundary disputes, Land tenure, Accretion (Legal aspects).

Plaintiff brought suit against defendant gravel company to recover the value of gravel allegedly taken from her land. The gravel was removed from a sand bar, opposite plaintiff's land, which plaintiff alleged was an accretion to her land. Defendant alleged that the bar was not an accretion to plaintiff's land but, being situate in the bed of a navigable river, was public domain. The central issue for determination was whether or not the stream was navigable. The Supreme Court of Arkansas stated that a riparian owner on a non-navigable stream takes title to the center of the stream ratably with other riparian owners, his extent of interest being dependent on the frontage of his land upon the stream. However, a riparian owner on a navigable stream takes only to the high water mark. Evidence adduced at trial was sufficient to show the stream was navigable and as such, precluded plaintiff's recovery. (Barnett-Florida)
W71-00976

COZY LAKE, INC V NYODA GIRL'S CAMP INC (RIPARIAN RIGHT TO NATURAL FLOW OF A STREAM).
128 A 149-150 (NJ 1925).

Descriptors: *New Jersey, *Dams, *Natural flow, *Riparian rights, Spillways, Streams, Channels, Streamflow, Flow, Regulated flow, Alteration of flow, Obstruction to flow, Judicial decisions, Natural flow doctrine, Riparian land, Riparian waters, Reasonable use.

In an action for an injunction, plaintiff, a lower riparian owner, contended that it was being deprived of the natural flow of water from a stream. Plaintiff contended that defendant, an upper riparian owner, had constructed a dam with insufficient spillways which resulted in the retardation of the flow of the stream. Defendant contended that the dam did not materially alter the flow of the stream. The court held that an upper riparian owner may use the water of a stream in a reasonable manner so long as he does not destroy, render useless or diminish the flow of the stream to a lower riparian. The court ruled that there was no evidence to support the claim that any water had been materially diverted from its usual channel or that the flow of the stream had been diminished by the dam. Consequently, plaintiff's bill for an injunction was dismissed. (Snow-Florida)
W71-00977

HENDRIX V MCEACHERN (LIABILITY FOR OBSTRUCTION OF NATURAL DRAINAGE OF UPPER LAND).
139 SE 9-11 (Ga 1927).

Descriptors: *Georgia, *Surface drainage, *Diversion, *Obstruction to flow, Discharge (Water), Natural flow, Surface water, Surface runoff, Drainage, Dams, Boundary disputes, Watercourses (Legal), Land, Land tenure, Damages, Legal aspects, Judicial decisions, Backwater, Reasonable use, Relative rights.

Plaintiff upper landowner brought action against defendant lower landowner to recover a strip of land allegedly taken by defendant and to recover damages which resulted from the construction on the strip of a wall which interfered with the natural drainage of plaintiff's land. Defendant contended that plaintiff had erected a garage on her land which interfered with the natural flow of water and caused it to be discharged at a different place on defendant's land and in a greater quantity than would normally occur. The trial court found for defedant, and the Supreme Court of Georgia affirmed. It is a settled rule that a lower landowner owes a servitude to an upper landowner to receive the water which naturally runs from it, provided the upper owner has not acted to increase the flow of such water by artificial means. The court found that plaintiff had so altered the natural flow of water, and under such circumstances defendant could protect the drainage of his own land. (Duss-Florida)
W71-00980

MASTEN V TEXAS CO (POLLUTION OF SUBSURFACE WATERS).
194 NC 540, 140 SE 89-90 (1927).

Descriptors: *North Carolina, *Water pollution, *Subsurface waters, *Wells, Underground streams, Watercourses (Legal), Soil contamination, Soil contamination effects, Water pollution effects, Water pollution sources, Gasoline, Flow, Natural flow, Legal aspects, Judicial decisions, Water quality.

Plaintiff's brought suite against defendant corporation for contamination of a well with gasoline from a tank on defendant's land. Evidence showed that plaintiffs' well water had been pure before installation of the gas tank. After installation, there was contamination, and an inspection of the tank showed a leak. From the trial court's granting of a nonsuit, plaintiffs appealed. An intermediate appellate court reversed and remanded the case for trial on the facts. Defendant appealed, and the Supreme Court of North Carolina affirmed. The evidence was sufficient to submit the issue of contamination to the jury. The court stated that one who, by permitting pollution of his own soil or water thereunder, contaminates his neighbor's wells or streams under his neighbor's land is liable in damages, and in some instances such pollution will be restrained by injunction. (Duss-Florida)
W71-00981

VIRGINIA HOT SPRINGS CO V HOOVER (LIABILITY FOR DIVERSION OF SPRING WATERS).
130 SE 408-411 (Va 1925).

Descriptors: *Virginia, *Diversion, *Streams, *Reasonable use, Springs, Judicial decisions, Legal aspects, Alteration of flow, Diversion structures, Natural flow doctrine, Riparian rights, Pipelines, Water supply, Riparian land, Riparian waters, Relative rights, Remedies, Intermittent streams, Spring waters.

Plaintiff landowners sued to restrain defendant resort hotel company from diverting the natural flow of a stream and thereby cutting off plaintiffs' sole water supply. Defendant had contracted with an upper riparian owner for the right to divert the spring waters feeding the stream, but plaintiffs contended that defendant was only entitled to divert as much water as the upland owner, a small farmer, would have used -- not the amount required for defendant's resort operation. Defendant contended that the normal streamflow did not reach plaintiffs' land during the dry season, which was the only time defendant diverted any water. Finding that the evidence supported plaintiffs' claim, the court affirmed a judgment for plaintiffs. (Liptak-Florida)
W71-00982

DEL BALSO HOLDING CORP V MCKENZIE (OWNERSHIP OF UPLAND AND RIPARIAN RIGHTS).
167 Misc 498, NYS2d 790-796 (1937).

Descriptors: *New York, *Riparian rights, *Administrative agencies, *High water mark, Low water mark, Judicial decisions, Legal aspects, Federal government, Riparian waters, Shores, Beds, Streams, Navigable waters, Construction, Piers, Cities, Boundaries, Tides, Channels, Weather patterns, Windtides, Winds, Topography, Maps, Land tenure, Real property.

Petitioner corporation sought an order of mandamus compelling the New York dock commissioner to permit petitioner to construct a pier on a creek. Petitioner alleged ownership of upland behind the point where the pier was to be erected, thereby giving petitioner riparian rights and the privilege of constructing a pier. The city opposed petitioner's claim by alleging the existence of a high water mark of the creek inshore of the boundaries of the upland claimed by petitioner. If such were the case, petitioner would have no rights in the land in question since the city was vested with ownership of land between the high and low water marks. Petitioner relied upon the dock department's prior use of a high water mark for many years which gave petitioner title to some upland. The city sought to establish a new high water mark, utilizing various findings of the federal government. The court found these new findings inconsistent in themselves and a departure from the city's own prior practices. The court held that petitioner had shown unequivocal title to the land in question, and under the accepted high water mark, was definitely the owner of some upland. Consequently, petitioner had the right to construct a pier. (Duss-Florida)
W71-00983

PLACE V UNION TOWNSHIP (MUNICIPAL LIABILITY FOR ALTERATION OF NATURAL DRAINAGE).
66 SW2d 584-591 (Mo 1934).

Descriptors: *Missouri, *Drainage, *Obstruction to flow, *Dams, Repulsion (Legal aspects), Overflow, Roads, Rivers, Levees, Floods, Legal aspects, Diversion, Alteration of flow, Surface waters, Natural streams, Watercourses (Legal), Surface runoff, Flood damage, Relative rights, Remedies, Flood plains, Natural flow, Drainage practices, Ditches.

Plaintiffs sought to force defendant township to rebuild several dams across a road ditch. It was alleged that the road and ditch cut across several ridges which had acted as natural levees protecting plaintiffs' property from floodwaters from a nearby river and from surface runoff. Defendant urged that any overflow resulted from surface waters, which under the 'common enemy rule' each landowner must repel as best he can, and therefore that removal of the dams had resulted in no legal injury to plaintiffs. The court rejected this contention, finding that the sloughs between the ridges were natural waterways. This being so, any diversion of the natural flow of such waterways gave rise to an actionable wrong to those injured thereby. The court found that construction of the road and ditch diverted floodwaters from their natural paths in the sloughs onto plaintiffs' property, and affirmed the trial court's judgment requiring defendant to rebuild the dams in question to prevent flood damage to plaintiffs. (Caldwell-Florida)
W71-00985

MOBILE AND O RR V TAYS (LIABILITY FOR ALTERATION OF SURFACE WATER FLOW BY CONSTRUCTION OF RAILROAD EMBANKMENT).
107 So 871-874 (Miss 1926).

Descriptors: *Mississippi, *Railroads, *Alteration of flow, *Flood damage, Bridges, Obstruction to flow, Natural streams, Diversion, Overflow, Structures, Legal aspects, Embankments, Natural flow, Streams, Surface waters, Surface runoff, Repulsion (Legal aspects), Relative rights, Judicial decisions, Construction, Culverts, Floods.

Defendant railroad had started to replace a trestle with an embankment. Plaintiff sought to enjoin this action, claiming that the embankment would divert surface runoff onto his property, thereby causing flood damage. The court denied the injunction, stating that plaintiff had failed to allege that the trestle was cheaper, safer and more convenient than the embankment. The court held that the duty imposed by law on railroads to provide suitable and safe roadways carried with it the right to construct embankments to support those roadways when necessary. When this right was exercised with due regard to the rights of adjacent landowners, any necessary injury resulting from the embankment must be borne by the owner. Plaintiff, by failing to allege that the trestle was cheaper, safer and more convenient, had failed to show sufficient injury to his property to allow an injunction to issue. (Caldwell-Florida)
W71-00986

TILDEN V SMITH (RIPARIAN OWNER MAY LOWER LAKE TO ORDINARY HIGH WATER MARK).
113 So 708-712 (Fla 1927).

Descriptors: *Florida, *High water mark, *Drainage wells, *Floodwater, Legal aspects, Judicial decisions, Remedies, Lakes, Water levels, Riparian rights, Riparian land, Riparian water, Floods, State governments, Legislation, Rainfalls, Weather, Banks, Vegetation, Water level fluctuations, Agriculture, Golf courses.

Plaintiffs sought to enjoin defendant from lowering the level of Lake Johns by drilling a deep well to let water drain underground. Defendant contented that the water level in the lake was excessively high because of abnormal rainfall and that his golf course, as well as property of other riparian owners, was flooded. Plaintiffs insisted that, if the level were lowered, they would receive less frost protection for their crops in dry years. The Supreme Court of Florida affirmed a lower court opinion denying the injunction. The court held that the state statute allowing an injuction against lowering of lake levels applied only to the ordinary high water mark, not the highest level the water reached. The court found sufficient evidence from vegetation and trees to establish that the ordinary high water mark was lower than the level at the time of plaintiff's suite. (Morris-Florida)
W71-00987

MAGINNIS LAND AND IMPROVEMENT CO V MARCELLO (OWNERSHIP OF BATTURE LANDS).
168 La 997, 123 So 653-655 (1929).

Descriptors: *Louisiana, *Accretion (Legal aspects), *Boundary disputes, *Bayous, Beds, Boundaries (Property), Prescriptive rights, Land tenure, Real property, Riparian land, Riparian waters, Riparian rights, Dry beds, Legal aspects, Judicial decisions, Maps, High water mark.

Plaintiff landowner sued ten defendant landowners to quiet title to batture property which was in defendants' possession. Plaintiff had sold lots to defendants but contended that the batture property was not included in the sale according to the recorded map of the property. Defendants contended that their deeds conveyed the land up to the water and that the batture property was theirs by right of accretion. Affirming a judgment for plaintiff, the court held that defendants' property boundaries were controlled by the recorded map where the deeds were in conflict with the map, and that the only evidence showed that the batture existed before plaintiff sold the lots to defendants. Therefore, the batture land was plaintiff's by right of accretion and was not included in the sale of the lots to defendants. (Liptak-Florida)
W71-00988

SMITH V MCELDERRY (RIPARIAN OWNER'S LIABILITY FOR DIVERSION AND ALTERATION OF NATURAL FLOW OF STREAM).
124 So 896-97 (Ala 1929).

Descriptors: *Alabama, *Diversion, *Natural flow doctrine, *Riparian rights, Obstruction to flow, Alteration of flow, Reasonable use, Streamflow, Riparian land, Riparian waters, Ditches, Legal aspects, Judicial decisions, Prescriptive rights, Remedies, Relative rights, Streams, Diversion structures.

Plaintiff riparian owners sued to restrain defendant riparian owner from diverting water from the stream separating their property. Plaintiffs contended that they were entitled to the natural flow of the stream and that defendant, by diverting water into a ditch which later emptied back into the stream, had reduced the stream flow so that the channel had become clogged with logs and debris and was therefore useless. Defendant argued that he had a prescriptive right to maintain the ditch, since it had been dug 25 to 40 years before he had

acquired the property, and also contended that he was under a duty only to maintain the streamflow as it existed when he purchased the property. Affirming a judgment for defendant, the court held that defendant had acquired a prescriptive right, particularly since plaintiffs had dug a similar ditch on their own property, and that defendant now had no right to materially alter the flow of the stream. (Liptak-Florida)
W71-00989

GREENFIELD V POWELL (TITLE DISPUTE TO LAND FORMED BY AVULSION).
127 So 171-173 (Ala 1930).

Descriptors: *Boundary disputes, *Avulsion, *Accretion (Legal aspects), *Alabama, Bank erosion, Stream erosion, Channels, Streams, Boundaries (Property), Legal aspects, Judicial decisions, Prescriptive rights, Remedies, Erosion, Riparian land, Riparian rights, Riparian waters, Real property, Land tenure, Sands, Gravels.

Plaintiff riparian owner brought action in ejectment against defendant riparian owner and also sought to recover damages for conversion of sand and gravel that defendant claimed by accretion. Plaintiff contended that the stream separating the lands in question had suddenly changed course because of a freshet which eroded plaintiff's banks and enlarged defendant's bank, that this action was due to avulsion, and, therefore, that defendant had no right to the newly formed land. Defendant contended that the land was formed by accretion, was therefore his, and that the sand and gravel deposited on his bank was not the same as that washed away from plaintiff's bank. Affirming a judgment for plaintiff, the court held that the evidence clearly showed a sudden and distinct change in the stream's channel. Such could only result from avulsion, and the new land formed on one side of the stream need not be the same that washed away from the other side. (Liptak-Florida)
W71-00990

WINEMAN V WITHERS (BOUNDARY DISPUTE OVER LAND FORMED IN NON-NAVIGABLE RIVER BY ACCRETION).
108 So 708-709 (Miss 1926).

Descriptors: *Mississippi, *Accretion (Legal aspects), *Boundary disputes, *Ownership of beds, Rivers, Non-navigable waters, Streams, Stream erosion, Boundaries (Property), Channel erosion, Bank erosion, Riparian Land, Riparian waters, Legal aspects, Judicial decisions, River beds, Real property, Running waters, Remedies, Erosion, Beds under water.

Plaintiff riparian owner sued defendant riparian owner to quiet title to land formed by accretion in front of their adjoining property. Prior to this accretion, the river bed had encroached on both parties' lands. Plaintiff contended that the boundary line should be drawn at a right angle to the thread of the stream from a point where the original property line intersected the river bed where it had encroached onto the property before the process of accretion began. Defendant contended that the line should be drawn at a right angle to the thread of the stream from a point where the boundary intersected the river bed at its original location before the encroachment and recession of the river. Affirming a judgment for defendant, the court held that upland owners on non-navigable rivers own the bed of such rivers to the middle of the stream, and therefore the encroachment and recession of the river in the instant case did not change the original boundary of the property which already belonged to the upland owners. The court also held that the boundary of the accreted land was properly drawn from the property line at the river bed's original location. (Liptak-Florida)
W71-00991

JAMES V HAMM (LIABILITY FOR FLOOD DAMAGE CAUSED BY CONSTRUCTION OF DITCHES).
1 SW2d 552-553 (Ark 1928).

Descriptors: *Arkansas, *Drainage practices, *Ditches, *Flood damage, Relative rights, Drainage, Streams, Overflow, Surveys, Floods, Levees, Damages, Alteration of flow, Obstruction to flow, Legal aspects, Surface runoff, Judicial decisions, Surface waters.

Defendant constructed a drainage ditch across his property. Plaintiff brought action for damages, claiming that the dirt from the excavation of this ditch formed a levee which caused water to overflow onto plaintiff's adjacent property. Defendant contended that plaintiff had wrongfully constructed several drainage ditches which resulted in channelling an increased amount of surface runoff toward defendant's ditch. Defendant alleged that, but for plaintiff's ditches, his ditch would have been adequate to take care of all the water flowing toward it from plaintiff's property. The court held that it was plaintiff's ditches rather than the levee which resulted in the damage. A lower court decision for defendant was affirmed. (Caldwell-Florida)
W71-00992

SMITH V CITY OF KUTTAWA (TITLE TO LAKE AND PARK).
222 Ky 569, 1 SW2d 979-985 (1928).

Descriptors: *Kentucky, *Lakes, *Cities, *Land tenure, Relative rights, Public benefits, Real property, Parks, Land use, Recreation, Easements, Legal aspects, Water rights, Maps, Judicial decisions.

Plaintiff sought to assert his title to a large tract of land as against defendant city. The land in question included a lake and areas that were being used as parks. Defendant argued that plaintiff's predecessor in title had granted an easement to the city and its citizens to use the lake for recreational and other purposes. Defendant further claimed that it had the fee simple title to the lake and park, basing its claim on an adverse possession and dedication. The court held that even though defendant's easement was never recorded, the use of the lake was so open and notorious that plaintiff took the land with notice of defendant's rights. The court also held, however, that defendant's rights had not ripened into a fee simple title, but that it merely retained an easement. Plaintiff was therefore declared to own the property in fee simple, subject to defendant's easement. (Caldwell-Florida)
W71-00993

WHITE CONST CO V BROOKS (LIABILITY FOR OBSTRUCTION OF STREAM ALLEGED TO HAVE CAUSED FLOOD DAMAGE).
222 Ky 621, 1 SW2d 1076-1079 (1928).

Descriptors: *Kentucky, *Obstruction to flow, *Flood damage, *Damages, Alteration of flow, Construction, Barriers, Diversion, Streams, Relative rights, Streamflow, Legal aspects, Adjudication procedure, Floods, Real property, Overflow, Excessive precipitation, Bridges, Judicial decisions.

Plaintiff landowner brought action against defendant corporation for damages, alleging that defendant had wrongfully torn down a bridge over a stream and filled in the stream with rock, thus causing plaintiff's land to be flooded. The court held that the testimony of a witness for defendant that the cause of plaintiff's flood damage was an extraordinary rainfall rather than the obstruction of the stream was wrongfully excluded. The court also held that in view of all the surrounding circumstances, including the fact that plaintiff had not requested removal of the obstruction until after the flood, an award of punitive damages was erroneous. The lower court's decision for plaintiff was reversed. (Caldwell-Florida)
W71-00994

FRAZIER V LOUISVILLE AND N RR (LIABILITY FOR FLOOD DAMAGES FROM EXTRAORDINARY RAINFALL).
231 Ky 107, 21 Sw2d 140-142 (1929).

Descriptors: *Kentucky, *Culverts, *Railroads, *Flood damage, Obstruction to flow, Surface runoff, Structures, Embankments, Excessive precipitation, Maximum probable flood, Surface waters, Drainage, Damages, Floods, Legal aspects, Relative rights, Overflow, Judicial decisions.

Plaintiff landowner brought action against defendant railroad to recover damages for injuries to this property. A flood in May 1927 left a culvert under a railroad embankment near plaintiff's house clogged with debris. Plaintiff claimed that defendant had negligently failed to clean out this debris which resulted in floodwaters backing up and damaging his house during a subsequent flood in July. The court held that defendant was only under an ordinary duty of care to avoid flood damage to plaintiff. The July flood was found to have been extraordinary and beyond anything that might reasonably have been anticipated. The court found that defendant had in fact cleaned out the culvert sufficiently to take care of any runoff that might ordinarily have been expected. The court held, therefore, that the unforseeable floods and not defendant's negligence had been responsible for the damage to plaintiff's house. The fact that plaintiff himself had done nothing to clear the culvert also weighed against him. (Caldwell-Florida)
W71-00995

CHESAPEAKE AND O RY V WEDDINGTON (LIABILITY FOR DAMAGES RESULTING FROM OVERFLOW OF CREEK).
231 Ky 745, 22 SW2d 131-133 (1929).

Descriptors: *Kentucky, *Railroads, *Landslides, *Overflow, Alteration of flow, Diversion, Obstruction to flow, Legal aspects, Right-of-way, Damages, Erosion, Relative rights, Streams, Flood damage, Real property, Channel flow, Judicial decisions, Floods.

Plaintiff landowner brought action against defendant railroad for damages which resulted to his land when an unusually large quantity of dirt and stones which defendant had piled upon its right-of-way slid of its own weight into an adjacent creek, forcing the creek waters to flow over plaintiff's property. Defendant contended that it had merely made use of its own land without negligence, any damage to adjacent landowners from such use being non-compensable. The court held that the unusual size of the pile, and the fact that it had slipped of its own weight into the creek, made the resulting injury a wrongful one. Since the injury was not of a class of incidental damages, unavoidable in the course of railroad operation, plaintiff could recover. The amount of the verdict for plaintiff was held to be excessive, however, and the case was remanded for a proper determination of damages. (Caldwell-Florida)
W71-00996

KENWELL V LEE (STATE PROPERTY NOT TO BE USED IN NON-MUNICIPAL WATER DISTRICT).
267 NY 481, 196 NE 406-408 (1935).

Descriptors: *New York, *Cities, *Water districts, *Project planning, Water policy, State governments, Local governments, Judicial decisions, Legal aspects, Lakes, Reservoirs, Land, Water supply, Municipal water, Legislation.

In a per curiam decision wherein the facts were not disclosed, the Court of Appeals of New York ruled that a state-owned lake and lands incidental to it could not be used as a reservoir in a proposed municipal water district. The proposal for the establishment of the water district was therefore null and void. (Barker-Florida)
W71-00997

MACLEOD V DAVIS (PRESCRIPTIVE RIGHT TO USE SEWER DRAIN).
290 Mass 335, 195 NE 315-217 (1935).

Descriptors: *Massachusetts, *Drains, *Prescriptive rights, *Sewers, Pipes, Easements, Adjudication procedure, Conduits, Drainage systems, Cities, Drainage practices, Drainage, Judicial decisions, Legal aspects, Relative rights.

Plaintiff landowner brought suit in equity to compel defendant to reopen a sewer drain which ran through defendant's property. Plaintiff's predecessor had installed the drain under agreement with defendant's predecessor, and the drain had been in use for over 30 years before defendant closed it. The Supreme Judicial Court of Massachusetts held that, based on all the evidence, plaintiff's right to use the drain had become a prescriptive right. Defendant could not interfere with such a right. (Barker-Florida)
W71-00998

HEINE V BANDELIER (DAMAGE FROM IMPROPER DRAINAGE PRACTICE).
190 NE 617-618 (Ind 1934).

Descriptors: *Indiana, *Drainage practices, *Drainage effects, *Riddance (Legal aspects), Drainage water, Damages, Drains, Tiles, Laterals, Conduits, Ditches, Discharge (Water), Runoff, Judicial decisions, Legal aspects, Adjudication procedure.

Plaintiff landowner brought suit against defendant neighboring landowner for damages allegedly caused when defendant collected and discharged large amounts of water onto plaintiff property. Plaintiff contended that the damages arose when defendant refused to connect lateral drains and when defendant constructed sewer drains which emptied onto plaintiff's land. Defendant argued that plaintiff was required to negative a claim of contributory negligence. The Appellate Court of Indiana ruled that in a case not based on negligent injury, the plaintiff need not present evidence to negative contributory negligence. The trial court's decision awarding damages to plaintiff was affirmed. (Barker-Florida)
W71-00999

KENWELL V LEE (STATE PROPERTY NOT TO BE USED IN NON-MUNICIPAL WATER DISTRICT).
261 NY 113, 184 NE 692-694 (1933).

Descriptors: *New York, *Cities, *Water districts, *Water supply, Project planning, Water policy, State governments, Local governments, Lakes reservoirs, Municipal water, Legislation, Administrative decisions, Judicial decisions, Legal aspects.

Plaintiff taxpayer brought suit against defendant town supervisor to prevent issuance of bonds to finance the establishment of a water district. The town had adopted a plan whereby a lake which was within a state-owned forest preserve would be used as a water supply for the water district. The boundaries of the town and the water district were identical. Permission for the establishment of the district had been granted by the State of New York, and plaintiff's challenge to the plan was dismissed by the trial and appellate courts. The Court of Appeals of New York reversed the lower decisions, holding that the state laws and constitution allowed for use of state-owned water only as a water supply for municipalities. A water district, as created in this case, did not come within the definition of 'municipalities' contemplated by such laws. Judgment for plaintiff was granted and the plan held invalid. (Barker-Florida)
W71-01000

WHITLING V TYLER (EQUITABLE RELIEF FROM OBSTRUCTION TO FLOW).
121 Ohio St 125, 167 NE 365-366 (1929).

Descriptors: *Ohio, *Remedies, *Obstruction to flow, *Backwater, Barriers, Watercourses (Legal), Damages, Flooding, Dams, Adjudication procedure, Judicial decisions, Legal aspects.
Identifiers: Injunctions (Prohibitory).

Plaintiff brought an action for damages and an injunction against defendant's obstruction of two watercourses which resulted in water backing up on plaintiff's property. Defendant denied the allegations, but the trial court granted plaintiff an injunction. The Supreme Court of Ohio, reversing for procedural errors, ruled that equitable relief to restrain obstructions to flow is not barred even though there may be an adequate remedy at law. (Barker-Florida)
W71-01001

MCKIERNANN V GRIMM (OBSTRUCTION OF NATURAL WATERCOURSE).

165 NE 310-311 (Ohio 1928).

Descriptors: *Ohio, *Obstruction to flow, *Alteration of flow, *Diversion, Natural flow, Natural flow doctrine, Barriers, Buildings, Relative rights, Boundaries (Property), Watercourses (Legal), Intermittent streams, Damages, Remedies, Judicial decisions, Legal aspects.

Plaintiff landowner sought an injunction against defendant neighboring landowner for the wrongful obstruction of a natural watercourse. Defendant had constructed a garage on his property and in so doing had obstructed the watercourse and caused the water to be diverted onto plaintiff's land. The trial court granted the injunction. In affirming, the appellate court ruled that proof of obstruction of a natural watercourse was sufficient for injunction. The court further ruled that the general rule of dominant and servient tenements does not apply when a servitude is created artificially. (Barker-Florida)
W71-01002

SICILIANO V BARBUTO (DISCHARGE OF COLLECTED WATER).
265 Mass 390, 164 NE 467-469 (1929).

Descriptors: *Massachusetts, *Snow, *Rain, *Buildings, Roofs, Precipitation (Atmospheric), Water, Damages, Drains, Flow, Remedies, Judicial decisions, Legal aspects, Discharge (Water).

Plaintiff landowner brought an action for injunction and damages against defendant neighboring landowner for the wrongful collection and discharge of water onto plaintiff's land. The trial court found that defendant maintained buildings whose eaves and drain troughs discharged water from rain and snow onto plaintiff's land. On appeal, the Supreme Judicial Court of Massachusetts held that such action was indeed tortious and affirmed the judgment for plaintiff. (Barker-Florida)
W71-01003

UNITED PAPER BOARD CO V IROQUOIS PULP AND PAPER CO (FLASHBOARDS WITHIN MEANING OF CREST OF A DAM).
164 NE 594-595 (NY 1928).

Descriptors: *New York, *Dams, *Floodgates, *Spillway crests, Adjudication procedure, Flow, Flow control, Judicial decisions, Legal aspects.
Identifiers: *Flashboards.

In a per curiam decision wherein the facts were not presented, the Court of Appeal of New York ruled that when a deed to water rights includes a provision that water shall flow over the crest of a dam, the top flashboards of the dam are to be considered as the crest of the dam. (Barker-Florida)
W71-01004

NANCE V MERCHANTS' FERTILIZER PHOSPHATE CO (LIABILITY FOR NEGLIGENCE IN POLLUTING A STREAM).

200 NC 702, 158 SE 486-490 (1931).

Descriptors: *North Carolina, *Water pollution, *Water pollution effects, *Water pollution sources, Judicial decisions, Adjudication procedure, Legal aspects, Streams, Surface waters, Damages, Remedies, Industrial wastes, Poisons, Toxins, Mortality, Fertilizers, Agricultural chemicals, Agriculture, Livestock, Animals, Domestic animals, Hogs, Stock water.

Defendant company's fertilizer plant discharged noxious chemicals into a stream near where plaintiff kept his hogs. During a period of heavy rainfall, the stream overflowed, depositing noxious substances in plaintiff's pasture. On two occasions a number of plaintiff's hogs died after consuming the polluted water. Plaintiff sought damages for defendant's allegedly negligent discharge of such chemicals. The trial court awarded plaintiff damages. Defendant contended on appeal that the deaths resulted from an act of God for which defendant was not liable. Defendant contended that the rainfall preceding the deaths was unprecedented. The Supreme Court of North Carolina affirmed. When negligence concurs with an act of God in producing an injury, the party guilty of such negligence shall be held liable for the consequences if the injury would not have occurred but for his failure to exercise due care. Defendant was obliged to use its property with care and was liable for the consequences of its negligence. (Dye-Florida)
W71-01005

HOLTON V NORTHWESTERN OIL CO (SURFACE WATER DRAINAGE AS NUISANCE).
201 NC 744, 161 SE 391-394 (1931).

Descriptors: *North Carolina, *Surface drainage, *Drainage, *Surface runoff, Adjudication procedure, Judicial decisions, Legal aspects, Damages, Runoff, Drainage water, Grading, Flow, Surface waters, Relative rights, Ditches, Drainage effects, Effects, Overlying proprietor, Remedies.

Defendant operated a service station on high ground adjacent to plaintiff's property and dwelling house. Water from defendant's ice box and water barrel drained into a ditch, which became filled with pop bottles, and overflowed onto plaintiff's property. Plaintiff sought damages and abatement of the drainage as a nuisance. The Supreme Court of North Carolina affirmed the trial court's judgment of non-suit. The court stated that the owner of lower land is obliged to receive surface water which falls on higher land and naturally flows onto lower land. (Dye-Florida)
W71-01006

COLLIER V GARNER (EQUITABLE RELIEF IN BOUNDARY DISPUTES).
170 SE 353-354 (Ga 1933).

Descriptors: *Georgia, *Boundary disputes, *Ownership of beds, *Remedies, Adjudication procedure, Legal aspects, Judicial decisions, Land, Real property, Streams, Streambeds, Beds, Banks, Land tenure, Bed under water, Boundaries (Property).

Defendant landowner owned property containing a creek. Defendant granted part of the land extending to one side of the creek to plaintiff's predecessor in title. When plaintiff attempted to remove rocks from his side of the stream, defendant interfered with the removal, claiming title to the entire stream. Plaintiff sued in equity to quiet title in the property to the thread of the stream. The trial court overruled defendant's demurrer, relying on a construction of the deed to plaintiff's predecessor giving plaintiff title to the thread of the stream. The Supreme Court of Georgia reversed. Adequate remedy was available to plaintiff through an action

at law in ejectment. The court stated that a court of equity will not quiet title where an adequate remedy exists at law. Plaintiff's complaint thus failed to state a cause of action, and defendant's demurrer should have been sustained. (Dye-Florida)
W71-01007

CHESAPEAKE AND O RY V CALDWELL (LIABILITY FOR DAMAGES RESULTING FROM INSUFFICIENT DRAINAGE THROUGH RAILWAY EMBANKMENT).
213 Ky 410, 281 SW 176-178 (1926).

Descriptors: *Kentucky, *Drainage, *Obstruction to flow, *Railroads, Adjudication procedure, Judicial decisions, Legal aspects, Barriers, Diversion, Relative rights, Drains, Culverts, Surface waters, Compensation, Damages, Drainage effects.

Plaintiff owned property adjacent to defendant railroad company's tracks. Defendant coal company constructed a switch from the main railroad tracks to its mines. The switch tracks were on a 6-foot embankment. Plaintiff brought an action for damages and other relief when insufficient drainage resulted in damage to plaintiff's property. Plaintiff obtained a judgment ordering defendants to improve culverts beneath the tracks. The instant action against the same defendants was brought when the enlarged culverts also proved inadequate. The trial court ruled for plaintiff on the basis of negligence by both defendants. Defendant railroad contended that it was not liable since the switch and culverts were built and maintained solely by defendant coal company. Defendant coal company claimed that the method of determining the proper amount of damages was improperly stated to the jury as being the diminution of value of the property rather than the decrease in its rental or use value. The court reversed as to defendant railroad and reversed and remanded as to defendant coal company for a new evaluation of damages. (Dye-Florida)
W71-01008

SPOO V GARVIN (OBLIGATION OF LOT OWNER TO GUARD AGAINST LOOSE SOIL FALLING ONTO ADJACENT LOT WHILE MAKING IMPROVEMENTS).
236 KY 113, 32 SW2d 715-717 (1930).

Descriptors: *Kentucky, *Damages, *Surface runoff, *Excavation, Judicial decisions, Legal aspects, Drainage, Drainage practices, Runoff, Surface waters, Embankments, Impounded water, Impoundments, Overland flow, Washouts.

Plaintiff landowner sought to recover damages and to enjoin defendant adjacent landowner from allowing surface water to wash over onto her property and carry with it loose soil from defendant's lot. Defendant denied plaintiff's allegations and by counterclaim contended that plaintiff's predecessor had lowered the level of her property by excavation so near his property line so as to cause his property to crumble over into plaintiff's lot during rainy periods. The court refused to hold plaintiff liable for an act of her predecessor. Plaintiff was entitled to remove soil that fell onto her lot, but was liable for the value of that soil appropriated for her use. The court stated that defendant, knowing drainage from his lot would fall on the adjoining lot when he was making improvements, should have guarded against loose dirt being carried thereto. The trial court had dismissed both claims, but had subsequently awarded nominal damages to defendant. The trial court's judgment was affirmed. (Price-Florida)
W71-01009

STATE V HUFFMAN (AVULSION EFFECTS NO CHANGE IN BOUNDARY LINES OF PROPERTY ABUTTING ON STREAM).
2 SW2d 582-584 (Mo 1938).

Descriptors: *Missouri, *Accretion (Legal aspects), *Avulsion, *Boundaries (Property), Boundary disputes, Missouri River, Channel morphology, Legislation, Legal aspects, Judicial decisions, Bank erosion, Erosion, Relative rights, Local governments.

In 1875 the boundary line between two counties was the middle of the Missouri River. The course of said river changed imperceptibly until 1915. At that time, the river abandoned its old channel suddenly by the process of avulsion. The dispute herein was whether the 1875 boundary line or the line established in 1922 to be in the center of the then abandoned river bed as it was in 1915, was to prevail. Plaintiff state argued for the 1875 boundary based on constitutional and statutory arguments, while defendant argued for the 1922 boundary based on case law and the common law. The court stated that where land is bordered on running water, and the banks gradually change by accretion, the stream continues to be the boundary line. However, where such a change occurs suddenly by avulsion, the boundary line remains in the center of the abandoned river bed. Therefore, the 1922 boundary set up in the abandoned river bed as it existed in 1915 following shifts due to accretion prevailed. The trial court's judgment for defendant was affirmed. (Price-Florida)
W71-01010

DOWNEY V PHELPS (TEST FOR DETERMINING WHETHER A TRACT IS DOMINANT OR SERVIENT TO ANOTHER.
208 NW 499-503 (Iowa 1926).

Descriptors: *Iowa, *Dikes, *Natural flow doctrine, *Overlying proprietors, Ditches, Levees, Natural flow, Floodwaters, Crop response, Drainage, Drainage effects, Drainage practices, Channel morphology, Ponds, Embankments, Discharge (Water), Overflow, Backwater, Diversion structures, Judicial decisions, Legal aspects, Land reclamation, Obstruction to flow.

Plaintiff landowners sought to enjoin defendants from maintaining a levee, or dike, on defendants' land, which allegedly obstructed the flow of water from plaintiffs' land. Defendants contended the damage to plaintiffs' land was due to natural causes. To be entitled to the relief sought, the court said that plaintiffs' would have had to show their land to be dominant to defendants' and that defendants' dike had impeded the natural flow of water from plaintiffs' property. All but one plaintiff had failed to prove their lands dominant to those of defendants', and as to him so proving, it was found that defendants' dike had no adverse effect on his land. As to which is the servient and which is the dominant estate in regard to the ordinary surface waters is determined by the relative elevation of the respective tracts, although it may be true that in times of flood both are entirely submerged and inundated. The trial court's judgment for plaintiffs was reversed. (Price-Florida)
W71-01011

JOHNSON V CHICAGO B AND Q RR (WAIVER OF RIGHT TO DAMAGES CAUSED BY OBSTRUCTION TO FLOW OF NATURAL DRAIN).
211 NW 842-846 (Iowa 1927).

Descriptors: *Iowa, *Obstruction to flow, *Easements, *Diversion, Damages, Surface waters, Natural flow, Natural flow doctrine, Bridges, Railroads, Missouri River, Right-of-way, Ditches, Drainage, Overflow, Diversion losses, Crop response, Drainage districts, Judicial decisions, Legal aspects, Real property, Land tenure.

Plaintiff brought action for damages allegedly caused by the obstruction of surface waters by defendant's railroad bridge. Plaintiff demurred to defendant's answer that it had been granted by plaintiff's predecessor in title the right to continue to maintain the bridge as it was originally constructed. It was so maintained at the institution of this action. The court concluded that plaintiff had the duty to inquire as to defendant's rights at the time plaintiff bought his adjacent property. A landowner may waive his rights to damages resulting from an obstruction causing a diversion of water from its natural course. Such a waiver was given to defendant by plaintiff's predecessor in title, and had plaintiff made inquiry in the exercise of reasonable diligence, he would have discovered the facts which he claimed had no binding effect on him. The judgment for defendant was affirmed. (Price-Florida)
W71-01012

VICK V STREHMEL (RIGHT OF UPPER PROPRIETOR TO CAST SURFACE WATERS OFF HIS PROPERTY).
222 NW 307-309 (Wis 1928).

Descriptors: *Wisconsin, *Surface drainage, *Surface waters, *Surface runoff, Drainage, Drainage water, Overland flow, Runoff, Watersheds (Basins), Drains, Flow, Natural flow, Judicial decisions, Relative rights, Overlying proprietor, Legal aspects, Flow augmentation.

Plaintiff landowner brought an action to enjoin defendant from using a drain to divert surface waters from defendant's land onto plaintiff's land. Plaintiff contended that the drain was used to remove a gathering of surface waters from defendant's land and that such surface waters would not have otherwise been cast upon plaintiff's land by any natural course. Defendant contended that surface water from his land flowed in the natural course of drainage to plaintiff's land and that the drain did nothing but hasten such flow. The court held that an upper proprietor has a right to rid his lands of surface waters by permitting or causing the same to flow in the natural drainage course onto adjoining lands. The court also held that such a proprietor can construct drains to carry surface waters where no new watershed is created. Thus from the evidence in the case, the court ruled that defendant had not acted improperly in constructing the drain to assist the flow of surface water along its natural course, even though the drain increased the water's flow. (Snow-Florida)
W71-01013

NORDLUM V GREAT NORTHERN RY (ALTERATION OF NATURAL COURSE OF DRAINAGE WATER BY RAILROAD BED CONSTRUCTION).
225 NW 145-146 (Minn 1929).

Descriptors: *Minnesota, *Surface drainage, *Surface waters, *Surface runoff, Drainage, Drainage water, Watersheds (Basins), Flow, Natural flow, Alteration of flow, Obstruction to flow, Damages, Flooding, Flood damage, Ponding, Judicial decisions, Overland flow, Railroads, Road banks, Adjudication procedure, Legal aspects.

Plaintiff brought an action to recover damages for alleged negligence by defendant railroad company. Plaintiff contended that defendant, by constructing a railroad bed adjacent to this property had altered the natural course of drainage which cased water to accumulate upon his land, to flood it and to injure his crops. Defendant contended that the railroad bed at no time was the cause of any flooding upon plaintiff's lands. The court reviewed the record and ruled that there was no evidence tending to show that the railroad bed interfered with the course of drainage. Thus the verdict for plaintiff was reversed and a new trial ordered. (Snow-Florida)
W71-01014

HICKEL V CHICAGO R I AND P RY (ALTERATION OF NATURAL COURSE OF DRAINAGE).
227 NW 419-421 (Iowa 1919).

Descriptors: *Iowa, *Surface drainage, *Culverts, *Alteration of flow, Watercourses (Legal), Flow, Drainage, Drainage water, Surface waters,

Watersheds (Basins), Conduits, Conveyance structures, Drains, Judicial decisions, Railroads, Roadbanks, Natural flow, Overland flow, Diversion, Natural flow doctrine, Legal aspects.

In a suit to restrain defendant railroad company from altering the natural course of drainage, plaintiff contended that defendant, by constructing a culvert through a railroad bed, cast drainage water upon his land. Plaintiff contended that but for the culvert altering the natural course of drainage, such water would have not flowed upon his land. Defendant contended that the natural course of the drainage was across plaintiff's land and that, were it not for defendant's roadbed, the drainage would in course be cast upon plaintiff's land. Thus defendant contended that the culvert was merely correcting the natural drainage course which had been altered by the construction of the roadbed. The court held that the evidence indicated that the natural course of drainage in that area was across plaintiff's land. Thus the construction of the culvert to restore the natural course, previously altered by the roadbed, was proper. (Snow-Florida)
W71-01015

PUTNAM V KINNEY (PUBLIC RIGHT TO FISH UPON NON-NAVIGABLE LAKE).
248 Mich 410, 227 NW 741-743 (1929).

Descriptors: *Ownership of beds, *Michigan, *Non-navigable waters, *Lakes, Fishing, Meanders, Navigable waters, Navigation, Riparian rights, Judicial decisions, Lake beds, Inland waterways, Lake shores, Shores, Federal Government, Surveys, Public rights, Riparian land, Legal aspects, Land tenure.

In an action for an injunction, plaintiff sought to restrain defendants from trespassing and fishing upon a lake on his property. Plaintiff contended that the inland lake was subject to his sole control in that he was the owner of all the land surrounding the lake. Defendants contended that they had a right of access to the lake and a right to fish upon the lake, such rights being the rights of the general public. Defendants contended that because the lake had been meandered by Federal Government surveyors, the lake was thus a public navigable lake, which gave the public a right to navigate it and to fish in its waters. The court held that the lake was not navigable in fact in that it was not capable of being used for purposes of commerce, trade or travel. The fact that the lake had been meandered was immaterial. The court held that the riparian proprietor owning all the shore line of an inland lake is the owner of the land underneath the lake and has the exclusive right to the use of the lake. Defendants were thus restrained from invading plaintiff's lake. (Snow-Florida)
W71-01016

BOARD OF SUPERVISORS V BOARD OF SUPERVISORS (COST SHARING BY ADJACENT DRAINAGE DISTRICTS).
241 NW 14-26 (Iowa 1932).

Descriptors: *Iowa, *Drainage districts, *Cost sharing, *Drainage systems, Governments, Controlled drainage, Ditches, Drainage effects, Drainage programs, Land management, Running waters, Surface waters, Water control, Water management (Applied), Remedies, Legal aspects, Cost allocation, Judicial decisions, Administrative agencies.

Plaintiff lower drainage district sought a writ of mandamus to compel defendant upper drainage district to assess the land within defendant district in order to pay a portion of the drainage improvement cost in plaintiff district. Plaintiff contended that the landowners in defendant district impliedly undertook to assume the burden of paying a portion of the cost of improving the ditches of the lower district by organizing the upper district and making improvements which would necessarily result in an increased flow to the lower district. Defendant contended that statutes providing for assessment to compensate for increased burdens on lower districts required that notice be given to those who might be assessed. Defendant further contended that no notice was given landowners residing in the upper district. The Supreme Court of Iowa held that the upper landowners were assessed with respect to the ratio of the district's outflow according to the statute and that no notice was required by the statute to those whose lands would not be taken for a right-of-way. The court ordered defendant to collect funds for the payment of their ratable portion of burden in the lower district's drainage system. (Quesada-Florida)
W71-01017

DALY V STATE (EXTRAORDINARY RAINFALL IS NO DEFENSE TO NEGLIGENCE IN MAINTAINING A CANAL).
226 App Div 154, 235 NYS 331-335 (1929).

Descriptors: *New York, *Floods, *Canals, *Rain water, Legal aspects, Judicial decisions, Remedies, Damages, Channels, Canal embankments, Drains, Ditches, Floodwater, Rain, Streams, Natural flow, Water injury, Farms, Crops, Streamflow, Forecasting, State Governments, Overflow, Excessive precipitation.

Plaintiff sued for damages which resulted to his crops when water from defendant state's Champlain Canal overflowed onto his farm. Plaintiff alleged that defendant was negligent in maintaining the unused canal. Defendant contended the overflow was caused by an extraordinary rainfall and that the overflow might have occurred even if the canal had not been there. The court, in reversing the trial court's judgment for defendant, held that extraordinary rainfall is not a defense to negligence although an act of God would be. The court also held that any consideration of whether the flooding would have occurred without the canal's presence was speculation. (Morris-Florida)
W71-01018

MANLEY V NEW YORK CENT RR (LIABILITY FOR IMPROVEMENTS WHICH BLOCK NEIGHBOR'S SURFACE DRAINAGE).
227 App Div 206, 237 NYS 273 (1929).

Descriptors: *New York, *Surface waters, *Drainage, *Repulsion (Legal aspects), Legal aspects, Judicial decisions, Remedies, Damages, Boundaries (Property), Surface runoff, Drainage water, Drainage pattern (Geologic), Railroads, Obstruction to flow, Barriers, Natural flow, Relative rights.

Plaintiff sought damages from defendant railroad company, alleging that defendant was blocking the flow of surface water off plaintiff's property. Defendant answered that any blockage occurred in the improvement and maintenance of its railroad lines. The natural flow of the surface waters was from plaintiff's land on and through defendant's land until defendant made the improvements. In a per curiam decision which reversed a lower court decision for plaintiff, the court held that defendant had a right to improve his property, even though it blocked the waters, as long as it did not act in bad faith or negligently. (Morris-Florida)
W71-01019

DOUNCE V CITY OF ELMIRA (LIABILITY FOR FLOOD DAMAGE).
237 App Div 379, 261 NYS 757-761 (1932).

Descriptors: *New York, *Floods, *Landfills, Legal aspects, Grading, Judicial decisions, Damages, Remedies, Local governments, Land forming, Streams, Rainfall, Streamflow, Channels, Floodwater, Drainage, Natural flow, Bridges, Flood damage, Surface waters, Excessive precipitation.

Plaintiff landowner sued defendant city for damages which resulted from the flooding of his land after defendant raised the level of certain land on the opposite side of a stream and built bridges over it. Plaintiff asserted that before defendant filled in such low-lying land, that land and not plaintiff's was flooded during flood season. Defendant insisted the flooding was caused by abnormal rainfall and not by its negligence. The court reversed a lower court judgment for plaintiff. The court found both sides of the stream had been filled so as to change the natural conditions and that the stream's floodwaters did not flow in defined channels but became surface waters. The court found defendant was not negligent in filling its own land or building the bridges, and that any damages to plaintiff were damnum absque injuria. (Morris-Florida)
W71-01020

JOHNSON V HUME (CONSTITUTIONALITY OF STATUTE GOVERNING CHANGE OF PROPERTY BOUNDARY DUE TO ACCRETION OR CHANNEL EROSION).
137 SE 56-57 (Ga 1927).

Descriptors: *Georgia, *Accretion (Legal aspects), *Boundaries (Property), *Channel erosion, Legislation, Legal aspects, Judicial decisions, Boundary disputes, Prescriptive rights, Land tenure, Real property, Non-navigable waters, Streams, Riparian rights, Riparian land, Riparian waters, Ownership of beds.

Plaintiff riparian owner sued to enjoin his grantor from trespassing on plaintiff's land. In reversing a judgment for defendant, the court held that a Georgia statute, which provided that property boundaries comprised of non-navigable streams changed when the channel of the stream gradually changed and that accretions on either side of the stream accrued to the adjacent landowner, did not violate the due process clauses of the state and federal constitutions. (Liptak-Florida)
W71-01021

COUCH V CLINCHFIELD COAL CORP (COAL COMPANY'S LIABILITY FOR DIVERTING FLOW OF PERCOLATING WATER).
139 SE 314-317 (Va 1927).

Descriptors: *Virginia, *Percolating water, *Alteration of flow, *Mining, Groundwater, Land subsidence, Overlying proprietor, Water sources, Water supply, Wells, Groundwater movement, Water wells, Water rights, Coal mines, Excavation, Appropriation, Natural flow doctrine, Preferences (Water rights), Judicial decisions, Legal aspects, Diversion.

Plaintiff landowner brought action against defendant coal company to recover damages resulting from a subsidence of defendant's adjacent property which caused plaintiff's well to dry up. Plaintiff contended that he was entitled to lateral and subjacent support and to the natural flow of the underground percolating water beneath his property. Plaintiff alleged that defendant was negligent in its mining operations, thereby causing the subsidence and the diversion of the water. Defendant contended that the doctrine of lateral and subjacent support was not applicable since plaintiff's property was not disturbed and no mining was done under his property. Furthermore, there was no liability for diverting undefined underground percolating water. Affirming a judgment for defendant, the court held that lateral and subjacent support did not apply. Moreover, no cases had been found denying landowners the right to divert percolating water--even though the diversion ruins a neighbor's well or underground spring. (Liptak-Florida)
W71-01022

MOODY V BURRELL (REMEDY FOR POLLUTION OF WATER SUPPLY BY DOMESTIC SEWAGE SYSTEM).
146 SE 753 (Ga 1929).

Descriptors: *Georgia, *Water pollution, *Domestic wastes, *Sewage disposal, Pollutants, Water pollution sources, Pollution abatement, Wastes, Water quality, Domestic water, Potable water, Water supply, Sewage, Septic tanks, Sewage systems, Spring water, Legal aspects, Judicial decisions, Remedies.
Identifiers: Injunction (Prohibitory).

Plaintiff hotel operator sued to restrain defendant property owner from constructing a septic tank and sewage system which allegedly would contaminate a spring which served as plaintiff's water supply for her hotel guests. Plaintiff further contended that the sewage system would infect her water supply and was therefore a nuisance. Defendant offered evidence that plaintiff's water supply would not be affected. In view of the sharply conflicting evidence, the court affirmed the order denying plaintiff an interlocutory injunction and dissolving the temporary restraining order. (Liptak-Florida)
W71-01023

MCNABB V HOUSER (DIVERSION OF WATER FROM A NON-NAVIGABLE STREAM).

156 SE 595-599 (Ga 1931).

Descriptors: *Georgia, *Division, *Natural flow doctrine, *Non-navigable waters, Streams, Streamflow, Obstruction to flow, Diversion structures, Alteration of flow, Riparian rights, Riparian land, Riparian waters, Ditches, Dams, Mills, Mill dams, Sawmills, Hydroelectric plants, Legal aspects, Judicial decisions, Remedies.
Identifiers: Injunction (Prohibitory).

Plaintiff riparian owner sued to enjoin defendant riparian owner from diverting water from a non-navigable stream flowing from defendant's property through plaintiff's property. Plaintiff contended that the ditch defendant was digging would interrupt the natural flow of the stream and would render plaintiff's corn mill, sawmill, cotton gin and hydroelectric plant inoperable. Defendant contended that there was more than eough water in the stream to supply plaintiff's several operations and defendant's mining operations and that plaintiff was estopped from complaining of the diversion after standing by silently while defendant expended large sums of money constructing the ditch. Affirming a judgment for plaintiff, the court held that any diversion was an interference with plaintiff's right to the natural flow of the stream and that plaintiff was not estopped from seeking an injunction since he was under no duty to speak and defendant had not relied on plaintiff's silence when he constructed the ditch. (Liptak-Florida)
W71-01024

INTERNATIONAL SHOE CO V GIBBS (POLLUTION OF STREAM BY MANUFACTURE).

36 SW2d 961-963 (Ark 1931).

Descriptors: *Arkansas, *Water pollution, *Industrial wastes, *Damages, Cattle, Pastures, Streams, Sewage, Septic tanks, Sewage disposal, Water pollution sources, Water pollution effects, Judicial decisions, Legal aspects, Adjudication procedure.

Plaintiff landowner sued defendant shoe manufacturer for pollution injury to a stream crossing plaintiff's land. Plaintiff rented the land for use as a cow pasture. A small dwelling on the property was also rented. Defendant constructed a septic tank on its adjacent land, and the tank overflowed into the stream. Plaintiff alleged that the sewage caused offensive odors, so that cattle refused to drink it, and that the dwelling was made uninhabitable. Accordingly, defendant contended the value of his land was diminished. Defendant argued that the injury was temporary rather than permanent and that the jury award was excessive. The court noted that defendant had not previously raised the question of permanent injury and, therefore, held that defendant could not complain on appeal that the injury was temporary. The jury verdict was held not to be excessive, and lower court's judgment for plaintiff was affirmed. (Hart-Florida)
W71-01025

PERRY V SIMPKINS (POLLUTION OF FARM AND STREAM BY FLUORSPAR MINE).
260 Ky 151, 84 SW2d 35-38 (1935).

Descriptors: *Kentucky, *Water pollution, *Mine wastes, *Farms, Agriculture, Damages, Water pollution effects, Water pollution sources, Pollutants, Crops, Flooding, Flood damage, Hydraulic mining, Sedimentation, Sediment discharge, Judicial decisions, Legal aspects, Adjudication procedure.
Identifiers: Injunction.

Plaintiff farm owner sued defendant fluorspar mining operator for pollution injury to a stream crossing plaintiff's land. Defendant's mining wastes discharged into the stream and caused the stream to fill with sediment. When the stream overflowed plaintiff's property, pollutants were deposited on the farmland. Defendant contended that no damage was proven and that the injunction granted by the chancellor below was too broad. Reviewing the chancellor's fact findings, the court held that the evidence sustained the finding of permanent damage. Finding that it only prohibited defendant from further pollution of the stream, the injunction was upheld by the court. (Hart-Florida)
W71-01026

FIRE DIST NO 1 V GRANITEVILLE SPRING WATER CO (PROPOSED DIVERSION OF SPRING WATERS AS A VIOLATION OF LOWER LANDOWNER'S RIPARIAN RIGHTS).

152 A 42-44 (Vt 1930).

Descriptors: *Vermont, *Percolating water, *Riparian rights, *Reasonable use, Natural flow, Relative rights, Groundwater, Surface waters, Diversion, Obstruction to flow, Water utilization, Springs, Streams, Reservoirs, Alteration of flow, Competing uses, Legal aspects, Surface-groundwater relationships, Judicial decisions.

Plaintiff sought to enjoin defendant from diverting water from a stream, claiming that a proposed development of such spring on defendant's property would result in the stream being prevented from flowing onto plaintiff's property. The court recognized that under Vermont law a landowner is the exclusive owner of all groundwater beneath his property. However, when the water comes to the surface and becomes part of a flowing stream, the landowner is held to a reasonable use standard in utilization of this water. Therefore, the court held that while plaintiff had no rights in the percolating waters under defendant's property, it did have a legal interest in the flowing spring waters against anyone who unreasonably diverted water in violation of plaintiff's riparian rights. The case was remanded for a factual determination of whether defendant's proposed diversion was reasonable. (Caldwell-Florida)
W71-01027

SCHLICHTKRULL V MELLON-POLLOCK OIL CO (ILLNESS CAUSED BY POLLUTION OF WELL).
301 Pa 560, 152 A 832-834 (1930).

Descriptors: *Pennsylvania, *Water pollution, *Saline water intrusion, *Water wells, Oil industry, Public health, Oil wells, Drilling, Oil fields, Saline water, Saline water-freshwater interfaces, Wells, Well casings, Groundwater, Water supply, Percolating water, Subsurface waters, Judicial decisions, Legal aspects, Adjudication procedure.

Plaintiff landowner brought suit for damages against defendant oil company. Defendant had drilled an oil well and thereby caused salt to accumulate in plaintiff's water well. Plaintiff's wife became ill and plaintiff claimed the illness was caused by the salt in the water. The Supreme Court of Pennsylvania, reversing the trial court's decision for plaintiff, ruled that before an action for negligence in drilling an oil well would lie, danger to public health must have been foreseeable. Plaintiff had not met the burden of proof requisite to such an action. (Barker-Florida)
W71-01028

SISTERS OF ST JOSEPH CORP V ATLAS SAND, GRAVEL AND STONE CO (FLOOD DAMAGE RESULTING FROM NEGLIGENTLY CONSTRUCTED CULVERT).
120 Conn 168, 180 A 303-07 (1935).

Descriptors: *Connecticut, *Culverts, *Surface runoff, *Overflow, Surface drainage, Flood damage, Drainage engineering, Legal aspects, Relative rights, Natural flow, Channel flow, Flow augmentation, Drainage practices, Repulsion (Legal aspects), Damages, Judicial decisions, Costs, Remedies, Streams, Riddance (Legal aspects).

Defendant corporation had constructed a culvert through which a creek ran upon leaving plaintiff's land. Plaintiff claimed the culvert was too small and was negligently constructed, thereby causing surface runoff to back up onto plaintiff's property. Defendant contended that most of the flood damage had been caused by increases of surface water flow into the creek resulting from street paving and laying of drains by the city. Finding no evidence indicating that any of plaintiff's damage was due to the city's actions, the court rejected defendant's claim. The court stated that defendants had a duty to keep a channel which would carry off the waters of the creek, even in times of heavy rain, in an amount equivalent to the natural capacity of the creek. The court rejected defendant's claim that the cost to it of repairing the culvert would be more than the value of any corresponding relief to the plaintiff. A lower court decision for the plaintiff was affirmed. (Caldwell-Florida)
W71-01029

DRUCE V BLANCHARD (NATURAL FLOW OF DRAINAGE CREATES EASEMENT).
338 111 211, 170 NE 260-264 (1930).

Descriptors: *Illinois, *Drainage, *Soil-water-plant relationships, *Water table, Lakes, Drainage water, Drainage effects, Surface waters, Topography, Soil water, Subsurface drainage, Excess water (Soils), Groundwater, Saturated soils, Water levels, Water level fluctuations, Easements, Ditches, Farms, Recreation, Legal aspects, Judicial decisions, Remedies, Dams.

Plaintiff farmers sought an injunction to keep defendants from constructing a dam for the purpose of raising the water level of a certain lake and improving it for recreational purposes. Plaintiffs claimed the increase in the water level would interfere with the drainage from their farms by raising the water table. Defendants contended that ditches already had lowered the lake's level and that it was impossible to determine what the natural level was. The Supreme Court of Illinois, in reversing the lower court's decision, held that an injunction should issue. The court stated that the owner of a dominant heritage has a natural easement for the flow of surface waters and the owner of the servient heritage cannot interfere therewith. (Morris-Florida)
W71-01030

LOGAN GAS CO V GLASCO (UNDERGROUND WATER MUST BE IN CHANNEL TO BE SUBJECT TO RIPARIAN RIGHTS).
122 Ohio St 126, 170 NE 874-877 (1930).

Descriptors: *Ohio, *Subsurface waters, *Groundwater movement, *Riparian rights, Springs, Artesian wells, Spring waters, Underground streams, Percolating water, Water sources, Riparian waters,

Riparian land, Water supply, Water shortage, Groundwater, Riparian water loss, Diversion losses, Channels, Legal aspects, Judicial decisions, Damages, Remedies.

Plaintiff farmer sued defendant company for damages suffered by the reduction in flow of a spring on plaintiff's property. Plaintiff asserted that the spring had furnished an abundant supply of water until defendant, while drilling a gas well a half-mile away, also drilled a water well. The Supreme Court of Ohio, in reversing the lower court's verdict for plaintiff, held that even conceding that defendant's well struck a vein of water serving plaintiff's well, there could be no recovery unless it was clearly shown that the underground water was in a defined and known channel. Channel water is subject to riparian rights underground as well as when it is on the surface. But underground water is presumed to be percolating, and an owner of land may use the percolating water under his land at his own will. (Morris-Florida)
W71-01031

MADDOCK V CITY OF SPRINGFIELD (FLOODING BY SURFACE WATER DRAINAGE).
281 Mass 103, 183 NE 148-149 (1932).

Descriptors: *Massachusetts, *Flooding, *Ponding, *Surface runoff, Drainage water, Riddance (Legal aspects), Slopes, Snowmelt, Time of concentration, Surface drainage, Cities, Ice skating, Landfills, Grading, Judicial decisions, Legal aspects, Natural flow doctrine, Alteration of flow, Relative rights, Snow, Rainfall, Impact (Rainfall).

Plaintiff landowner sued defendant city for damages caused by surface water draining from defendant's lot onto plaintiff's lot. Plaintiff and defendant owned contiguous lots fronting on a street. Defendant constructed a sidewalk along his lot several inches higher than the grade established by a municipal survey. Defendant then filled in the lot from the sidewalk to the middle, creating a low area which filled with frozen water in the winter sufficient for a skating pond. With the spring thaw, this accumulated water flowed onto plaintiff's lot, thereby flooding his cellar. Plaintiff contended that defendant was under a duty to prevent his injury. The court noted that, in absence of an easement or agreement, neither owner could regulate the flow of surface water. The retention of the water on defendant's lot was determined to be immaterial. The court stated that defendant was free to grade and fill his lot as he chose so long as water was not collected and discharged in a channel over plaintiff's lot, and held that defendant was not liable for plaintiff's injury. The lower court's decision for defendant was affirmed. (Hart-Florida)
W71-01032

PEOPLE EX REL CARLSTROM V HATCH (TITLE DISPUTE TO LAND WITHIN IMPROPERLY ESTABLISHED MEANDER LINES).
350 Ill 586, 183 NE 610-613 (1932).

Descriptors: *Illinois, *Lakes, *Meanders, *Boundary disputes, State governments, State jurisdiction, Water resources development, Boundaries (Property), Swamps, Surveys, Mapping, Maps, Legal aspects, Judicial decisions, Land tenure, Real property.
Identifiers: *Title disputes.

Plaintiff state brought action to quiet title in lands held by defendant swamp owner. The disputed land was originally within a meander line established by a United States surveyor. However, after discovery that the meander line was improperly established where there was no navigable lake, a new survey and plat had been made. At that time, title to the land was in the United States, who conveyed it to plaintiff; plaintiff reconveyed to the local county. Defendant claimed title by adverse possession from the county. Plaintiff contended that all lands within the meander line were held in trust for the people. The court agreed that this was generally true, but noted that a surveyor, by drawing a meander line on a survey, could not create a lake where one did not exist. The new survey had nullified the meander line. Holding that the further conveyance to the county was valid, and that defendant had established adverse possession against the county, the court affirmed the lower court's decision for defendant. (Hart-Florida)
W71-01033

GAUVREAU V GULF REFINING CO (LIABILITY FOR POLLUTION OF WATER BY LEAKING GASOLINE TANK).

288 Mass 54, 192 NE 220 (1934).

Descriptors: *Massachusetts, *Water pollution, *Gasoline, *Leakage, Legal aspects, Judicial decisions, Damages, Water pollution effects, Water pollution sources, Wells, Artesian wells, Poisons, Fuels, Oil, Maintenance, Repairing, Installation, Adjudication procedure.

Plaintiff wife and daughter sued defendant oil company for pollution of a well and injury to their health. Defendant had installed gasoline tanks and pumps on plaintiff's property under a contract with the husband of plaintiff. Defendant claimed the contract gave the husband the duty to maintain the tanks. The lower court instructed the jury that plaintiffs could recover from defendant only for negligent installation of the tanks, and the jury found no negligence. The Supreme Judicial Court of Massachusetts stated that the replacement of a leaky pipe by defendant was not an admission of liability and held that the trial court's instruction was proper. (Morris-Florida)
W71-01034

ROOT REFINERIES, INC V ROBERTSON (POLLUTION OF FARM STREAM BY OIL REFINERY).
3 SW2d 57-58 (Ark 1928).

Descriptors: *Arkansas, *Water pollution, *Oil industry, *Dairy industry, Oil, Oil wastes, Oily water, Water pollution sources, Compensation, Damages, Streams, Water pollution effects, Pollutants, Judicial decisions, Legal aspects, Adjudication procedure, Leases, Rent, Cattle.
Identifiers: Nuisance (Continuing).

Plaintiff leaseholder sued defendant oil refinery for pollution injury to a stream which plaintiff used to water dairy cattle. Defendant had permitted oil to discharge into the stream, rendering it unfit for the cattle. Defendant contended that the stream had never been suitable for watering cattle and that the pollution was a permanent injury rather than a continuing nuisance. The appellate court, holding that the evidence clearly pointed to both the prior fitness of the stream for watering cattle and to pollution by defendant, affirmed the lower court's judgment for plaintiff. The court further held that since defendant could easily have prevented escape of oil into the stream, and since plaintiff was not the owner of the tract but a tenant at sufferance, the injury was a continuing nuisance. The proper measure of damages was the diminution in rental value. (Hart-Florida)
W71-01035

BLANKENSHIP V KANSAS EXPLORATIONS, INC (DAMAGES FOR POLLUTION OF MILLPOND BY MINE SLUDGE).

30 SW2d 471-480 (Mo 1930).

Descriptors: *Missouri, *Mills, *Sludge, *Damages, Water pollution, Mine wastes, Mill dams, Mineral industry, Mine drainage, Mining, Compensation, Streams, Ponds, Sludge disposal, Profit, Depreciation, Costs, Judicial decisions, Legal aspects, Adjudication procedure.
Identifiers: Injury (Temporary), Injury (Permanent).

Plaintiff millowner sued defendant mining company for damages from pollution. Defendant's plant was upstream from plaintiff's dam and millpond, and the mining wastes discharged into the stream by defendant caused the millpond to fill with sludge. As a result, the water power from the stream was insufficient to operate the mill. Defendant contended that the injury was temporary rather than permanent. Sustaining this assertion, the court held that the trial court should have submitted the issue to the jury. However, the court noted that plaintiff's failure to allow the stream to run the sludge from the pond did not relieve defendant from liability. Furthermore, it was found that plaintiff could recover for the lesser of: the diminution in the mill's market value, or the cost of removing the sludge. If plaintiff recovered the diminution in market value, he could not recover for lost profits. Lost profits could be recovered if removal cost was less than the diminution in market value. (Hart-Florida)
W71-01036

NORTON COAL MINING CO V WILKIE (POLLUTION OF FARM BY COAL WASHERY).

224 Ky 192, 5 SW2d 1058-1061 (1928).

Descriptors: *Kentucky, *Water pollution, *Coal mining wastes, *Damages, Water pollution effects, Water pollution sources, Pollutants, Farms, Agriculture, Crops, Crop production, Flooding, Flood damage, Coal mines, Hydraulic mining, Sedimentation, Sediment discharge, Judicial decisions, Legal aspects, Adjudication procedure.

Plaintiff farm owner sued defendant coal mining company for pollution of a stream coursing plaintiff's farm, the pollution resulting from defendant's coal washery. Plaintiff alleged that the pollution sediment injured his soil and crops when the stream overflowed. The court held that: (1) in order to recover for crop damage, plaintiff must show the diminution in crop profits for each year involved; (2) court instructions should confine damage recovery to injury proximately caused by the pollution; and (3) plaintiff could not recover for injury which could have been avoided by reasonable care. The evidence presented by plaintiff was too vague and intangible to support the jury verdict, and the court therefore reversed the lower court's judgment for plaintiff. (Hart-Florida)
W71-01038

CITY OF NEW YORK V THIRD AVE RY (EXTENT OF RIPARIAN RIGHT OF ACCESS TO NAVIGABLE RIVER).
264 App Div 193, 34 NYS2d 874-876 (1942).

Descriptors: *New York, *Riparian rights, *Relative rights, *Navigable rivers, Riparian land, Riparian waters, Navigable waters, Ownership of beds, Docks, Piers, Rivers, Judicial decisions, Structures, Cities, Land tenure, Legal aspects, Access routes.

In a per curiam decision, the court considered the relative rights of plaintiff and defendant to the use of a navigable river passing through plaintiff municipality and adjacent to property owned by defendant. The court held that defendant, as a riparian owner, had a right to access to the river for the purpose of loading and unloading boats, drawing nets and the like. As an incident to those rights, the riparian owner could erect such structures as a dock or pier between the upland and the navigable water. However, inasmuch as plaintiff was the owner of the property between the upland and the navigable water, the riparian owner had no right to construct structures which would occupy a substantial area and which would be used as an extensive storage facility. The trial court's judgment for defendant was reversed, and a new trial was ordered. (Snow-Florida)
W71-01039

KUNKLE V BOROUGH OF FORD CITY (OBSTRUCTION TO FLOW OF SWAMP DRAINAGE).
305 Pa 416, 158 A 159-161 (1931).

Descriptors: *Pennsylvania, *Watercourses (Legal), *Obstruction to flow, *Drainage water, Drainage, Adjudication procedure, Natural streams, Judicial decisions, Legal aspects, Cities, Local governments, Running water, Streams, Eminent domain, Real property, Land, Surface drainage, Paving, Roads, Surface waters, Precipitation excess, Runoff, Storm runoff, Diversion, Swamps.

Plaintiff landowner brought an action in trespass contending that defendant city's street improvements had diverted a natural watercourse, causing surface water to collect on plaintiff's property. Plaintiff's property was south of a swamp and north of a public road. In times of heavy rainfall, water from the swamp flowed across plaintiff's land, beneath the road, and onto property south of the road. Defendant's road improvements obstructed drainage beneath the road and allowed water draining from the swamp to collect north of the road on plaintiff's property. Defendant contended that the route of water from the swamp was not a natural watercourse and was subject to lawful diversion. The Supreme Court of Pennsylvania agreed with defendant. A natural watercourse is one ordinarily evident and not solely dependent on rains for its existence. Water drained from this swamp only in times of extraordinarily heavy rainfall. An eminent domain action was plaintiff's proper remedy. (Dye-Florida)
W71-01040

LACKAWANNA MILLS V SCRANTON GAS AND WATER CO, (NON-RIPARIAN RIGHTS TO WATER).
150 A 633-636 (Pa 1930).

Descriptors: *Pennsylvania, *Usufructuary right, *Appropriation, *Water rights, Prior appropriation, Riparian rights, Prescriptive rights, Legal aspects, Judicial decisions, State governments, Water contracts, Regulation, Water sources, Dams, Reservoirs, Streams, Water supply, Supply, Pipelines, Industrial water, Water users, Industrial plants, Mills.

Plaintifff companies and their predecessors in title had for years used the waters of a nearby stream to supply the water needs of their plants located on nonriparian lands. Defendant water company undertook to dam the stream at its source and executed contracts with plaintiffs' predecessors for the sale of water to them for an indefinite period at a specified price. This action was commenced by plaintiffs when the contract price was declared discriminatory, and defendant sought to charge plaintiffs the price specified by the Public Service Commission. Plaintiffs contended that the contract represented recognition by defendant of plaintiffs' property right in the water and estopped defendant from denying such a right or charging a higher rate. Defendant contended that plaintiffs' execution of the contract represented admission by plaintiffs of defendant's ownership of water rights in the stream. The court stated that plaintiffs' rights to water at the contract price ceased when the rate became discriminatory, and affirmed the lower court's judgment for defendant. (Dye-Florida)
W71-01041

DONNELLY BRICK CO V CITY OF NEW BRITAIN (POLLUTION OF RIPARIAN WATERS).
137 A 745-749 (Conn 1927).

Descriptors: *Connecticut, *Water pollution, *Riparian rights, *Flooding, Water pollution sources, Water pollution effects, Public rights, Judicial decisions, Legal aspects, Waste disposal, Sewage disposal, Adjudication procedure, Riparian land, Municipal wastes, Cities, Local governments, Streams, Real property, Damages, Domestic wastes, Drainage, Floods, Precipitation excess.

Defendant city increased the flow of water in a stream through plaintiff's property by obstructing the flow of upper branches of the stream and emptying into the stream waste waters not natural to the watershed. A heavy flood caused the polluted waters of the stream to overflow plaintiff's dikes and inundate his land. Plaintiff sought damages and an injunction restraining defendant from further polluting the stream. Plaintiff contended that he was entitled to the use of the stream containing only its natural waters and that the city's pollution of the stream constituted a continuing nuisance. Defendant contended that disposal of the sewage was a public necessity and administered with reasonable care. The Supreme Court of Errors of Connecticut reversed the lower court's judgment for defendant. Public necessity does not excuse impairment by an upper riparian owner of a lower riparian owner's right to natural flow. The pollution of the stream was a continuing nuisance for which defendant was liable in damages. The court further stated that the act of God doctrine is not applicable unless an unprecedented storm is the sole cause of injury. (Dye-Florida)
W71-01042

ROSE V SOCONY-VACCUUM CORP (POLLUTION OF STREAMS BY SUBSTANCES IN GROUNDWATER).
173 A 627-632 (RI 1934).

Descriptors: *Rhode Island, *Seepage, *Water pollution, *Percolating water, Riparian rights, Relative rights, Water pollution effects, Streams, Groundwater, Judicial decisions, Legal aspects, Riparian land, Percolation, Subsurface waters, Underground streams, Groundwater movement, Path of pollutants, Soil water movement, Oily water, Oil wastes, Water pollution sources.

Defendant operated a refinery on property adjacent to that of plaintiff. On plaintiff's property were a well and a stream used by plaintiff to water his pigs and hens. Collections of petroleum products on defendant's land entered percolating waters beneath the land and thereby passed to the water sources on plaintiff's land. This rendered the water unfit for animal consumption and caused the death of numbers of plaintiff's poultry and livestock. Plaintiff sought damages and an injunction, alleging that defendant was perpetuating a nuisance on his property. No negligence was alleged. Defendant's demurrer was sustained, and the appellate court affirmed, rejecting the doctrine of Rylands v Fletcher and stating that negligence must be shown for recovery where pollution is spread by percolating waters. The rule that one riparian owner may not injure another's use of the water was held to apply to surface streams and not to percolating waters, where the location and course of the water is generally unknown. (Dye-Florida)
W71-01043

BARRINGTON HILLS COUNTRY CLUB V VILLAGE OF BARRINGTON (DISCHARGE OF SEWAGE INTO RIPARIAN WATERS).
357 Ill 11, 191 NE 239-244 (Ill 1934).

Descriptors: *Illinois, *Water pollution, *Sewage disposal, *Cities, Riparian rights, Water pollution sources, Water pollution effects, Legal aspects, Adjudication procedure, Judicial decisions, Local governments, State governments, Municipal wastes, Domestic wastes, Streams, Eminent domain, Compensation, Riparian land, Relative rights, Public rights, Waste disposal, Pollution abatement.

Plaintiff riparian landowners sought to restrain defendant village from dumping sewage into a stream adjacent to their properties. Evidence demonstrated the existence and source of the pollution, which plaintiffs contended was a private nuisance. Defendant contended that: (1) the creation by the state of a sanitary water board removed jurisdiction from the court; (2) the value of sewage disposal should be balanced against damages to plaintiffs; and (3) defendant's sewage treatment plant was the most modern available, and (4) the village had the inherent right to discharge sewage water into the stream since it was the only water available therefor. The Supreme Court of Illinois affirmed for plaintiffs. The sanitary water board had jurisdiction over cases involving public rights only. This case involved private rights. Moreover, the city had no inherent right to dump sewage. It could not impinge upon the private rights of riparian owners without eminent domain proceedings and compensation. Plaintiff riparian owners had the right to have the stream carry only water naturally coming from their watershed. (Dye-Florida)
W71-01044

HENDRIX V ROBERTS MARBLE CO (RIPARIAN RIGHTS LIMITED TO RIPARIAN LAND).
165 SE 223-226 (Ga 1932).

Descriptors: *Georgia, *Diversion, *Riparian land, *Riparian rights, Alteration of flow, Water utilization, Pipelines, Water distribution (Applied), Pipes, Dams, Damsites, Reservoirs, Pumping, Reasonable use, Remedies, Judicial decisions, Legal aspects, Riparian water.

Plaintiff riparian landowner sold his right to use the water of a stream to a non-riparian landowner who installed a pipe to divert the flow of the water. Defendant riparian owner cut the pipe in order to have the normal flow of the stream continue, and plaintiff sought to enjoin defendant's interference. Defendant claimed that plaintiff riparian owner could not convey the right to use the water to a non-riparian owner. The Supreme Court of Georgia ruled that riparian rights are appurtenant only to lands which actually touch on the watercourse. A riparian owner may not convey to another the right to use the water on non-riparian land physically separated from the watercourse. The injunction sought by plaintiff was denied, and defendant was granted an injunction against plaintiff's maintenance of the pipeline diversion. (Barker-Florida)
W71-01045

MASONITE CORP V BURNHAM (LIABILITY FOR WATER POLLUTION).
146 So 292-296 (Miss 1933).

Descriptors: *Mississippi, *Damages, *Water pollution, *Industrial wastes, Discharge (Water), Boundaries (Property), Community development, Easements, Judicial decisions, Land tenure, Legal aspects, Proprietary power, Riparian land, Riparian rights, Riparian waters, Watercourses (Legal), Water wastes (Pollution), Domestic wastes, Sewage, Remedies, Relative rights, Wastes, Waste disposal.

Defendant corporation discharged effluent into a stream which flowed across plaintiff's property. A nearby municipality had purchased the right to pollute the same stream with sewage long before plaintiff acquired his land. It was apparent from the facts that after defendant began emptying its waste into the stream, the degree of pollution increased. In reversing the trial court's judgment for plaintiff, the Supreme Court of Mississippi held that where different parties discharge sewerage and filth into a stream which intermingles and causes an actionable nuisance, such parties are not jointly liable for damages where there is no common design or concert of action, but each is liable only for his proportion of the damages. Consequently, plaintiff's damages were limited to those attributable to the additional pollution in the stream caused by defendant's discharge of waste. (Clarke-Florida)
W71-01046

CITY OF CAPE GIRADEAU V HUNZE (MEASURE OF DAMAGES FOR STREAM POLLUTION CAUSED BY CITY SEWAGE DISTRICT).
284 SW 471-482 (Mo 1926).

Descriptors: *Missouri, *Water pollution, *Sewage districts, *Condemnation, Water pollution sources, Pollutants, Riparian rights, Riparian land, Riparian water, Wastes, Municipal wastes, Sewage, Sewage disposal, Drainage systems, Cities, Damages, Compensation, Eminent domain.

Plaintiff city sought to condemn an easement across defendant's property for a new sewer main and to acquire the right to use a stream traversing defendant's property for an overflow outlet for the city's sewer district. Defendant appealed from the damage award and claimed that the city's disposal of sewage into the stream would cause water pollution which would in turn cause great damage to him. Plaintiff argued that the stream was already polluted by slaughter houses upstream, that the sewer overflow into the stream would be minimal and that riparian owners could not complain of ordinary pollution. The court noted that riparian owners are subject to pollution caused by natural drainage of other riparian land, but held that plaintiff could not collect and discharge sewage into the stream in an amount greater than existing pollution. After reviewing the conflicting evidence, the court affirmed the damage award. (Liptak-Florida)
W71-01047

FACKLER V CINCINNATI NO AND TP CO (PROOF OF DAMAGES REQUIRED IN ORDER TO ENFORCE COVENANT NOT TO OBSTRUCT NATURAL STREAMFLOW).
229 Ky 339, 17 SW2d 194-196 (1929).

Descriptors: *Kentucky, *Dams, *Contracts, *Water demand, Damages, Water utilization, Water distribution (Applied), Remedies, Legal aspects, Judicial decisions, Concrete structures, Diversion structures, Reservoirs, Deflection, Riparian rights, Reasonable use, Streamflow, Obstruction to flow, Natural flow, Alteration of flow.

Plaintiff lower riparian landowner sought an injunction against defendant railroad company to prevent defendant from damming a stream which flowed from defendant's land onto plaintiff's land. Plaintiff contended that defendant had entered into a covenant with plaintiff in which defendant agreed not to prevent the stream from flowing onto plaintiff's land in any way. Defendant acknowledged the covenant but contended that in order for such an injunction to issue, plaintiff had to prove damages from the damming of the streamflow. While holding that a riparian proprietor is entitled to have water flow onto his land in its natural course undiminished in quantity and unimpaired in quality, the Court of Appeals of Kentucky found that plaintiff had failed to establish such damages as were necessary in order for an injunction to issue based on a convenant not to prevent natural streamflow. (Quesada-Florida)
W71-01048

SQUAW ISLAND FREIGHT TERMINAL CO V UNITED STATES (DAMAGES TO ISLAND FROM FAILURE TO MAINTAIN DIKE).
89 Ct Cl 269-278 (1939).

Descriptors: *Dikes, *Flood damage, *United States, *Storms, Weather patterns, Damages, Floods, Flood protection, Water injury, Legislation, Federal government, Administrative agencies, Islands, Project planning, Judicial decisions, Legal aspects.

Plaintiff island owner sued defendant United States for damages arising from defendant's failure to maintain a dike to protect plaintiff's island. There was an 8-foot channel along plaintiff's island, and an artificial 3 1/2-foot dike between the channel and the island. Defendant increased the channel depth to 22 feet, but did not strengthen the dike. Because of increased water flow in the deeper channel, several annual storms broke the dike. Plaintiff contended that defendant was negligent in failing to strengthen the dike. Defendant asserted that unprecedented storms were the proximate cause of plaintiff's injury. The court found that the storms were not unusual. Furthermore, the court, noting that it was common knowledge that water pressure increased proportionately with volume and velocity, concluded that defendant should have realized the consequences of its inaction. The court held defendant liable for the injury, giving judgment without interest for plaintiff. (Hart-Florida)
W71-01049

NORFOLK SOUTHERN RR V UNITED STATES (FEDERAL GOVERNMENT'S LIABILITY FOR ORDERING REMOVAL OF RAILROAD BRIDGE TO IMPROVE NAVIGATION).
96 Ct Cl 357-377 (1942).

Descriptors: *United States, *Channel improvement, *Bridges, *Condemnation, Condemnation value, Eminent domain, Navigation, Navigable waters, Canals, Railroads, Federal jurisdiction, Legal aspects, Judicial decisions, Federal government, Legislation, Rivers and Harbors Act, Inland waterways, Virginia, Compensation.
Identifiers: Intracoastal waterway.

Plaintiff railroad brought an action against defendant United States to recover damages cuased by plaintiff's replacement of a bridge under defendant's orders so that defendant could deepen and widen a canal to be used in the intracoastal waterway. Plaintiff contended that the order amounted to a taking of property and the governmental immunity had been waived by an act of Congress. Defendant argued that the government had the power to order removal of obstructions to navigation, that the exercise of that power was not a taking of property and that the act of Congress simply conferred jurisdiction on the court to hear the claim but did not create any liability. The court noted that Congress had considered all the facts and all the decisions concerning sovereign immunity. Therefore, for the act to have any meaning at all, it must have been intended to create liability where there ordinarily is none. Consequently, the court held that plaintiff was entitled to a judgment for damages. One judge concurred on the ground that the bridge was not an obstruction to navigation when it was ordered destroyed since only later was the canal widened. Therefore, the order to replace the bridge was a taking of property. (Liptak-Florida)
W71-01050

NORTHWEST RR V UNITED STATES (STRUCTURES ERECTED IN BED OF NAVIGABLE STREAM SUBJECT TO DESTRUCTION WITHOUT REMEDY BY UNITED STATES IN AID OF NAVIGATION.

100 Ct Cl 396-413 (1943).

Descriptors: *Virginia, *Eminent domain, *Navigation, *High water mark, Damages, Compensation, Riparian rights, Leases, Mining, Dams, Flooding, Overflow, Vegetation, Ownership of beds, Legislation, Federal government, Condemnation value, Judicial decisions, Legal aspects, Rivers and Harbors Act, Channel improvement, United States.

Plaintiff corporation constructed a coal tipple in a navigable stream. Subsequently, the level of the river was raised by defendant United States, which caused plaintiff's property to be overflowed and its tipple to be rendered useless. Plaintiff sought damages for injury to its land and reimbursement for the cost of the tipple. Defendant contended that only the value of the overflowed land above the ordinary high water mark was recoverable. The court stated that the high water mark is the line where the water stands sufficiently long to destroy vegetation below it. A riparian owner owns to the low water mark under Virginia law, but title to the bed of the stream up to the ordinary high water mark is subject to a paramount servitude in the United States in the interest of navigation. He who erects a structure in the bed of a navigable stream must do so with the knowledge that the United States can, in the aid of navigation, raise the high water mark so as to destroy or impair the utility of the structure. Consequently, plaintiff was entitled to recover damages for the land overflowed, but not for damage to the tipple. (Price-Florida)
W71-01051

UNITED STATES V APPALACHIAN ELECTRIC POWER CO (FEDERAL GOVERNMENT'S REGULATORY AUTHORITY OVER HYDROELECTRIC PLANT ON A NON-NAVIGABLE, INTERSTATE RIVER).
107 F2d 769-810 (4th Cir 1939).

Descriptors: *Rivers and Harbors Act, *Hydroelectric project licensing, *Non-navigable waters, *Federal jurisdiction, Interstate rivers, Dams, United States, Hydroelectric plants, Federal Power Act, Legislation, Permits, Administrative agencies, Virginia, Navigable rivers, Regulation, Judicial decisions, Legal aspects, Eminent domain, Condemnation, Riparian rights, Navigation, Federal government, Administrative decisions.

Plaintiff United States sued defendant electric power company to enjoin construction of a dam and electric power plant on an interstate river. Defendant had not obtained a license from the Federal Power Commission. Plaintiff contended that the river was navigable and therefore subject to the Rivers and Harbors Act. The act prohibited obstructions to navigation without the consent of Congress or a license from the Power Commission. Defendant argued that the river was not navigable, that Congress' power was limited to control of navigation, and that any controls not connected with navigation were an invalid taking of property. Affirming a judgment for defendant, the court reviewed extensive evidence and concluded that the river's navigability was not established. The Power Commission's authority did not extend to the dam project except to the extent that the dam might possibly affect navigation on other rivers. One justice dissented. (Liptak-Florida)
W71-01052

DIEHM V BOROUGH OF NEW HOLLAND (DAMAGES FOR DIVERSION OF WATER FLOW).
191 A 393-395 (Pa Super 1937).

Descriptors: *Pennsylvania, *Water sources, *Riparian rights, *Diversion, Streams, Spring waters, Water supply, Riparian land, Riparian waters, Alteration of flow, Domestic water, Obstruction to flow, Stock water, Judicial decisions, Reasonable use, Streamflow, Natural flow, Springs, Usufructuary right, Water users, Relative rights.

Plaintiff, a riparian owner, brought an action against defendant, an upper riparian owner, for damages for diverting creek waters from plaintiff's land. Plaintiff contended that defendant piped water away from a spring which supplied the creek and as a result the flow of the creek became so small as to be insuffucient for plaintiff's reasonable domestic and stock purposes. Defendant contended that the taking of the water had not diminished the flow to any appreciable extent in that the spring contributed but a small part to the creek's flow. The court held that there was sufficient evidence to indicate that the flow of the creek had been materially diminished and that such flow was insufficient to meet plaintiff's needs. The court thus held that plaintiff's riparian right to the flow of the stream had been violated and that he was entitled to damages for such violation. (Snow-Florida)
W71-01053

VILLAGE OF WOODBRIDGE V BOGAN (EMINENT DOMAIN AND LIABILITY FOR DAMAGES DUE TO WATER POLLUTION).
291 NYS 381-382 (App Div 1936).

Descriptors: *New York, *Sewage disposal, *Water pollution, *Damages, Boating, Condemna-

tion, Condemnation value, Outlets, Waste disposal, Sewerage, Land, Land appraisal, Land ownership, Lakes, Ponds, Legal aspects, Judicial decisions, Eminent domain, Compensation, Property values, Discharge (Water).

Plaintiff municipality condemned defendants' lands which bordered a lake for the purpose of constructing a sewage plant. Discharge from the proposed plant was to empty into the lake. Defendants were awarded the value of the land condemned and damages for injury to defendants' bathing and boating business which would result from the sewage discharge. Plaintiff appealed such award. The appellate court affirmed per curiam, holding that the evidence supported the award. Two judges would have affirmed but reduced the amount of the award. (Duss-Florida)
W71-01055

SCIENTIFIC HYDROLOGY IN THE WORLD,
Utah State Univ., Logan. Coll. of Engineering.
For primary bibliographic entry see Field 02A.
W71-01072

EASTON V STATE (AMOUNT OF COMPENSATION FOR TAKING OF LAND AND POLLUTING A STREAM).

153 Misc 395, 275 NYS 119-121 (1934).

Descriptors: *New York, *Water pollution, *Subsurface waters, *Compensation, Underground streams, Springs, Watercourses (Legal), Channels, Damages, Flow, Water quality, Water sources, Spring waters, Construction, Grading, Legal aspects, Judicial decisions, Land, Condemnation.

Claimants sought an award for land appropriated for railroad grade elimination purposes and for damages alleged to have been caused when such construction resulted in the pollution of a spring located on county property, the waters of which claimants had reserved to themselves in their instrument of conveyance. The Court of Claims found that claimants were entitled only to the value of the land taken. The spring in question was entirely fed by subterranean waters whose sources and channels were unknown. Liability for interference with such waters can only be sustained upon the theory of negligence. There was no proof that defendant had not done its work in a proper manner. Claimants relied solely on the fact that before construction the spring contained pure water and afterwards the water was unfit. The court held that such was insufficient evidence to prove negligence. (Duss-Florida)
W71-01073

SOUTHERN NEW ENGLAND ICE CO V TOWN OF WEST HARTFORD (CITY LIABLE FOR NUISANCE CAUSED BY DUMPING SEWAGE INTO STREAM).
159 A 470-477 (Conn 1932).

Descriptors: *Connecticut, *Municipal wastes, *Lake ice, *Prescriptive rights, Ice, Water pollution, Ponds, Water pollution effects, Water pollution sources, Sewage, Local governments, Sewage bacteria, Waste identification, Streams, Condemnation, Sewers, Sewage disposal, Flow, Riparian rights, Water rights, Legal aspects, Judicial decisions, Remedies, Damages.

Plaintiff ice dealer sued for damages caused when sewage from defendant city's sewers polluted the pond it cut ice from, thereby forcing its disuse for ice making. Defendant contended plaintiff had no legal right to take the ice. The evidence was clear that the ice was satisfactory until defendant's overflow sewer began dumping raw sewage into a stream that flowed into the pond. The Supreme Court of Errors of Connecticut affirmed a verdict for plaintiff, holding that ice had been harvested from the pond for more than 40 years by plaintiff and its predecessors, and thus plaintiff had a prescriptive right to the flowage of the stream and pond. Defendant had a right to construct sewers, but when such sewers constituted a nuisance, defendant was liable for damages occasioned thereby. (Morris-Florida)
W71-01074

RAU V URBAN (LIABILITY FOR PREDECESSOR'S IN TITLE ACTS).
155 A 498-499 (Conn 1931).

Descriptors: *Connecticut, *Watercourses (Legal), *Obstruction to flow, *Diversion, Overflow, Streams, Land tenure, Natural flow, Relative rights, Beds, Natural streams, Channels, Grading, Legal aspects, Judicial decisions, Damages, Impounded waters.

Plaintiff brought suit against defendants to restrain defendants' obstruction of a natural watercourse which resulted in the overflowing of plaintiff's land. Defendants contended that the alleged obstruction was committed by their predecessors in title, and therefore they could not be held liable. From the trial court's judgment for plaintiff, defendant appealed. The Connecticut Supreme Court of Errors affirmed. The finding that defendants and their predecessors obstructed the flow of the watercourse and caused the overflow was supported by the evidence. Defendants could be properly held liable for their predecessor's acts in obstructing the natural flow of water if defendants were given notice of the obstruction and requested to remove it. (Duss-Florida)
W71-01075

LEITCH V SANITARY DISTRICT (RIPARIAN RIGHTS AND OBSTRUCTIONS TO NAVIGATION).
386 Ill App 433, 54 NE2d 458-462 (1944).

Descriptors: *Illinois, *Navigable waters, *Riparian rights, *Navigation, Transportation, Damages, Nabigable rivers, Watercourses (Legal), Cities, Bridges, Sewers, Conduits, Administrative agencies, Riparian land, Landfills, Construction, Structures, Solid wastes, Wastes, Legal aspects, Judicial decisions, Rivers.
Identifiers: Obstruction to navigation.

Plaintiff riparian owners sought a mandatory injunction against defendant city and its sanitary district to require removal of obstructions from a watercourse. Plaintiffs alleged that their rights of ingress, egress and navigation to a branch of the Chicago River were destroyed by the filling in of such branch, the construction of a sewer and the construction of a permanent bridge. Defendants put in issue paintiffs' ownership of riparian property, the navigability of the branch and its use for transportation. Defendants also denied filling in the branch and alleged that the bridge had been constructed by the State of Illinois. The trial court ruled for defendants and plaintiffs appealed. The Supreme Court of Illinois affirmed. Plaintiffs failed to prove that either defendant constructed the permanent bridge which was the obstruction which cut off navigation from plaintiffs' property except for those boats able to pass under it. The main obstruction by defendants was the sewer which was well below the surface and allowed ample clearance for boats then using the river. Defendants did run a water main along the bridge, but it did not lower the clearance of such bridge. Requiring defendants to remove these structures would have been of no benefit to plaintiffs, and courts will not require performance of a useless act. (Duss-Florida)
W71-01076

OLD DOMINION LAND CO V WARWICK COUNTY (COUNTY HAS LIMITED POWER TO PROHIBIT POLLUTION IN NAVIGABLE RIVER.

200 SE 619-622 (Va 1939).

Descriptors: *Virginia, *Sewage disposal, *Water pollution control, *Navigable rivers, Legal aspects, Judicial decisions, Remedies, Ownership of beds, Navigable waters, Riparian rights, River beds, Local governments, State governments, Regulation, Tidal waters, Tidal effects, Sewers, Septic tanks, Sewage treatment, Water rights, Public rights, Public health, Jurisdiction, State jurisdiction, Sewage.
Identifiers: *Nuisance.

Petitioner land company was convicted of violating county ordinances which prohibited connecting new residences to unapproved sewer systems and emptying untreated sewage into the James River. Petitioner contended that since the acts had not been shown to be a nuisance or injurious to the health of the community, the county had no authority to enact the ordinances. The court stated that only the state legislature has the power to govern sewage emission into tidal waters, unless there is a nuisance or injury to the public health of a community, since such waters are controlled by the state for all the public. Since the James River was navigable, the court held the county ordinances invalid, and reversed the trial court's conviction of petitioners. (Morris-Florida)
W71-01077

O'NEAL V ROLLINSON (RIPARIAN RIGHTS EXTEND PERPENDICULAR TO LAND).

212 NC 83, 192 SE 688-690 (1937).

Descriptors: *North Carolina, *Boundaries (Property), *Riparian land, *Riparian rights, *Riparian waters, Legal aspects, Judicial decisions, Remedies, Ownership of beds, Beds under water, Navigable waters, Banks, Channels, River beds, Docks, Coastal structures, Shores.

Plaintiff riparian owner sought an injunction against a neighboring riparian owner to require removal of a wharf extending onto plaintiff's riparian property. The wharf was built from defendant's land but was T-shaped. The court upheld the lower court's judgment for plaintiff, ruling that riparian rights extend at right angles from the shore line to the edge of the deep water or channel, so that riparian rights lines are parallel to each other. The court noted that if riparian rights were determined by merely extending the angle of property boundaries, some riparian owners' rights would not extend to the deep water line. (Morris-Florida)
W71-01078

FITZSIMMONS V CASSITY (OWNER OF LAND TAKEN BY RIVER RECEIVES TITLE TO OLD RIVER BED).
172 So 824-829 (La Ct App 1937).

Descriptors: *Louisiana, *Boundaries (Property), *Ownership of beds, *Avulsion, Accretion (Legal aspects), *River beds, Legal aspects, Judicial decisions, Remedies, State governments, Local governments, Legislation, Erosion, Navigable waters, Navigable rivers, Surveys, Lumber, Water utilization, Hunting, Game birds, Public rights, Public lands.

Plaintiff sought an injunction to keep defendant from cutting trees and erecting an artificial duck blind on his property. The land in question previously was the bed of a navigable river whose course had changed. This change had resulted in the taking of other property previously owned by plaintiff. Plaintiff contended that under the state civil code, ownership of the prior river bed shifted to him to replace this loss of land. Defendant contended that ownership of the bed remained in the sovereign, and thus the land was subject to use by the public. The Court of Appeal of Louisiana affirmed the lower court's decision for plaintiff, holding that the civil code applied to give the river bed to the owner of land appropriated by the river. The court stated that the principle is similar to that of eminent domain, except the river acts on its own rather than through government action. (Morris-Florida)

W71-01079

TRANSCONTINENTAL PETROLEUM CORP V TEXAS CO (TITLE TO BEDS OF NAVIGABLE STREAM).
209 La 52, 24 So2d 248-256 (1945).

Descriptors: *Louisiana, *Navigable waters, *Ownership of beds, *Leases, Accretion (Legal aspects), Legal aspects, Judicial decisions, Streams, Navigation, State governments, Vegetation, Streamflow, Streambeds, Silting, Sediments, Silts, Water levels, Water level fluctuations, Geologic investigations, Soil investigation, Watercourses (Legal).

Plaintiff corporations sought to have their mineral lease from the state recognized as including the bottom of a certain watercourse. To do so over the competing claim of defendant corporations, plaintiffs had to show that the watercourse was a navigable stream in 1812 since that was the year Louisiana entered the Union and the state acquired title to the beds of navigable streams by virtue of its sovereignty. If the watercourse was not navigable at that time, the state would not have had title to lease to plaintiffs. The Supreme Court of Louisiana stated that a body of water is navigable when it is rendered available for commerce, whether it is actually so used or not. The court concluded there was not enough evidence to determine whether the stream was or was not navigable in 1812, and thus plaintiffs had failed to carry through the burden of proof needed to support its claim. The trial court's judgment for defendant was affirmed. (Morris-Florida)
W71-01080

FITZGERALD V FORTIER (LIABILITY FOR OBSTRUCTION OF WATERCOURSES).
For primary bibliographic entry see Field 02E.
W71-01082

FOSTER V MALSBURY (INJUNCTIVE RELIEF FOR OBSTRUCTION OF WATERCOURSE).
157 NE 446-448 (Ind Ct App 1927).

Descriptors: *Indiana, *Obstruction to flow, *Watercourses (Legal), *Natural flow doctrine, Dams, Levees, Streams, Beds, Banks, Flow, Channels, Damages, Alteration of flow, Construction, Sands, Gravels, Legal aspects, Judicial decisions, Riparian rights, Natural flow.

Plaintiff sought a mandatory injunction for removal of a dam built by defendants across the bed of a natural watercourse which flowed through defendants' and plaintiff's land. Plaintiff alleged the stream had been the natural watercourse since time immemorial, and defendants' construction would destroy the value of plaintiff's land. Defendants denied the allegations and counterclaimed that the dam in question had been in existence since time immemorial. The lower court found for plaintiff, issued the injunction and assessed nominal damages. The Appellate Court of Indiana affirmed. The findings of fact by the trial court were supported by the evidence. It is well settled that the right to an unobstructed flow of water in its natural channel will be sustained by injunction. Finally, the trial court's decree was specific enough to inform defendants of the exact size and location of the dams which they were being forced to remove. (Duss-Florida)
W71-01083

SCHWARTZ V WAPELLO COUNTY (PUBLIC RIGHTS TO NATURAL DRAINAGE).
227 NW 91-93 (Iowa 1929).

Descriptors: *Iowa, *Surface drainage, *Public rights, *Easements, Natural flow, Natural streams, Surface drainage, Surface water, Administrative agencies, ditches, Culverts, Damages, Legal aspects, Judicial decisions, Watercourses (Legal), Diversion, Discharge (Water), Overlying proprietor, Surface runoff, Remedies.

Plaintiff lower landowner sought to enjoin defendants county and upper landowner from installing a culvert which was designed to drain surface water from defendant upper landowner's property across a highway to a ditch on plaintiff's land. The evidence showed that such installation would reestablish partially the natural drainage of the land. Plaintiff contended, however, that the highway authorities had established a system of drainage which avoided plaintiff's land, that this system had been continued for more than ten years and that therefore it had become a natural watercourse which defendants had no power to change to plaintiff's detriment. The trial court dismissed plaintiff's petition and the Supreme Court of Iowa affirmed. Evidence showed that defendants were attempting to effect better drainage so as to improve the highway's condition. The public's rights were at stake and the statute of limitations could not be urged or claimed against the public. It is Iowa law that an easement exists for the drainage of upper land through lower land by means of natural drainage. (Duss-Florida)
W71-01084

6F. Nonstructural Alternatives

MANAGING THE NATURAL ENVIRONMENT: A REGIONAL PLAN FOR WATER, SEWAGE, AIR AND REFUSE,
Tri-State Transportation Commission, New York.
For primary bibliographic entry see Field 05G.
W71-00829

FLOOD PLAIN INFORMATION, GASTONIA, NORTH CAROLINA.
Corps of Engineers, Charleston, S.C.
For primary bibliographic entry see Field 04A.
W71-00846

FLOOD PLAIN INFORMATION, LITTLE, BOLIN, BOOKER AND MORGAN CREEKS, CHAPEL HILL, NORTH CAROLINA.
Corps of Engineers, Wilmington, N.C.
For primary bibliographic entry see Field 04A.
W71-00847

FLOOD PLAIN INFORMATION, BRUSH CREEK, NORTH HUNTINGDON TOWNSHIP, PENNSYLVANIA.
Corps of Engineers, Pittsburgh, Pa.
For primary bibliographic entry see Field 04A.
W71-00892

U.S. GEOLOGICAL SURVEY FLOOD-MAPPING PROGRAMS,
Geological Survey, Fairfax, Va.
For primary bibliographic entry see Field 07C.
W71-01056

SPECIAL FLOOD HAZARD INFORMATION REPORT ON SOUTH LEE COUNTY COASTAL AREAS.
Corps of Engineers, Jacksonville, Fla.

Corps of Engineers Special Flood Hazard Information Report, July 1970. 6 p, 8 fig, 9 plate.

Descriptors: *Floods, *Tides, *Flood damage, Flood plains, Regional flood, Flood forecasting, Flood control.
Identifiers: *Tidal flooding, Flood records, Standard project flood, Intermediate regional flood, Flooded area maps, September 1960 hurricane.

Tidal flooding in Florida along the south shore of Caloosahatchee River from the vicinity of W. P. Franklin Lock near Olga to the mouth of the river, and the offshore keys and low coastal lands south of Punta Rassa and west of U. S. Highway 41 is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections, and text material relating the extent of past flooding to floods which might occur in the future are based on available records of hurricanes, rainfall, runoff, historical flood heights and other technical data. (Woodard-USGS)
W71-01057

FLOOD PLAIN INFORMATION OF LICKING RIVER, CAMPBELL AND KENTON COUNTIES, KENTUCKY.
Corps of Engineers, Louisville, Ky.
For primary bibliographic entry see Field 04A.
W71-01095

FLOOD PLAIN INFORMATION STUDY, PIGEON CREEK, VANDERBURGH COUNTY, INDIANA - MAIN REPORT.
Corps of Engineers, Louisville, Ky.
For primary bibliographic entry see Field 04A.
W71-01096

6G. Ecologic Impact of Water Development

INITIAL ENVIRONMENTAL STUDY.
Erie and Niagara Counties Regional Planning Board, Grand Island, N.Y.

Available from NTIS as PB-193 321, $3.00 in paper copy, $0.95 in microfiche. June 1970. 85 p. HUD Project NYP-215.
Identifiers: *Urban planning, *New York, Natural resources, Air pollution, Water pollution, Recreation, Industries, Sanitary engineering, Education, *Regional planning and development, *Erie County (NY), *Niagara County (NY).

The report documents the basic environmental data dealing with natural features and man-made activities which have environmental significance. Discusses and maps source of air, water and land pollution and indicates areas most affected. Recommendations include priority problems to be addressed, priority areas to be protected and a scenic corridor concept which would both eliminate some of the problems and include some of the protection areas.
W71-00785

07. RESOURCES DATA

7A. Network Design

ACQUISITION AND MACHINE PROCESSING OF SALINE WATER DATA FROM SOUTHEASTERN NEW MEXICO AND WESTERN TEXAS,
Geological Survey, Albuquerque, N. Mex.
For primary bibliographic entry see Field 07C.
W71-00572

OPTIMUM GAGING STATION LOCATION,
Geological Survey, Washington, D C.
For primary bibliographic entry see Field 06A.
W71-00721

A HYDROLOGIC INVENTORY SYSTEM,
State Univ. of New York, Binghamton. Dept. of Geology.
Marie Morisawa.
Water Resources Bulletin, Vol 6, No 5, p 794-801, September-October 1970. 8 p, 4 fig, 4 tab, 11 ref. OWRR Project C-1314.

Descriptors: *Data collections, *Hydrologic data, *Water resources development, Runoff, Discharge (Water), Hydrologic budget, Water quality, Duration curves, Low flow, Peak discharge, Conservation, Water conservation, Ohio, Wyoming.
Identifiers: Water resources inventory, Green River (Wyo), Little Miami River (Ohio).

The decision making process in development of water resources has often been subjective. A scheme for inventorying the hydrologic properties of watersheds would be a powerful tool, providing objective criteria that can be used in judgments and which can be applied in surveys for water management or conservation purposes. Such an inventory was used in studying the Green River, Wyoming and Little Miami, Ohio. The classification system considered characteristics of the water budget, variability and reliability of flow, and water quality. Class ranks for water budget were based on amount of runoff and water loss. Regulation and variation in flow were ranked on impoundments, variability index, coefficient of variability, 90% flow duration, and maximum flow index. Chemical and solid loads were also considered. Classification of the Green and Little Miami Rivers pointed out distinctive differences between their hydrologic characteristics. The inventory can thus be examined to compare stretches of river or whole watersheds, objectively determining the best possible use. (Knapp-USGS)
W71-01097

7B. Data Acquisition

FIELD MEASUREMENT OF SOIL WATER DIFFUSIVITY,
Wisconsin Univ., Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 02G.
W71-00557

AN AIRBORNE MEASUREMENT OF THE SALINITY VARIATIONS OF THE MISSISSIPPI RIVER OUTFLOW,
Lockheed Electronics Co., Houston, Tex., and National Aeronautics and Space Administration, Houston, Tex.
For primary bibliographic entry see Field 02K.
W71-00562

REMOTE ANALYSIS OF FLUORESCENCE BY A FRAUNHOFER LINE DISCRIMINATOR,
Geological Survey, Washington, D. C.; and Perkin-Elmer Corp., Norwalk, Conn.
For primary bibliographic entry see Field 02K.
W71-00565

MEASURING FLOW THROUGH CREST GATES,
Corps of Engineers, Pittsburgh, Pa.
George E. Terney.
Water Resources Research, Vol 6, No 5, p 1396-1397, October 1970. 2 p.

Descriptors: *Flowmeters, *Discharge measurement, *Stream gages, *Low flow, *Movable dams, Hydraulics, Strain gages, Instrumentation, Measurement, Current meters.
Identifiers: Movable-crest dams.

Equipment was developed for the measurement of flow through crest gates on movable-crest dams. Because of divergency of flow upstream of gate openings, conventional flow measuring devices are not applicable. This system suspends a strain gage and sensor in the flow and measures the resultant forces on the sensor. (Knapp-USGS)
W71-00582

AN IMPROVED METHOD FOR SIZE DISTRIBUTION OF STREAM BED GRAVEL,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02J.
W71-00585

A NEW CONDUCTIVITY METHOD FOR DETERMINING CONCENTRATIONS IN PARALLEL PLATE MODELS,
Guelph Univ. (Ontario).
Y. Bachmat, and D. W. Lawson.
Journal of Hydrology, Vol 11, No 2, p 145-158, August 1970. 14 p, 9 fig, 2 tab, 5 ref.

Descriptors: *Hydraulic models, *Groundwater movement, *Instrumentation, *Electrical conductance, Water levels, Solutes, Tracers, Ion transport, Salinity, Flow, Percolation, Velocity, Mixing.
Identifiers: Parallel-plate models.

A new electrical-conductivity method was developed to determine solute concentrations in parallel plate sand models of flow in porous media. The method consists of using two circular electrodes mounted flush in the opposing walls of the model and facing each other on a common normal to the walls. Such an arrangement provides measurements which are averaged across the thickness of the medium and does not modify the local flow pattern or cause local variations in the packing of the porous medium. A method is developed which can be used to determine the volume of the porous medium that is being sampled. The measurements are stable and reproducible for platinum and platinized titanium electrodes and a glass bead medium at concentrations greater than 0.01 N CaC12. Each electrode pair must be calibrated in the model in the presence of the porous medium. (Knapp-USGS)
W71-00593

RIVER DISCHARGE MEASUREMENT BY THE RISING FLOAT TECHNIQUE,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Meteorological Physics.
A. J. Dyer.
Journal of Hydrology, Vol 11, No 2, p 201-212, August 1970. 12 p, 6 fig, 1 tab, 2 ref.

Descriptors: *Current meters, *Stream gages, *Discharge measurement, Instrumentation, Calibrations, Stage-discharge relations, Velocity, Currents (Water).
Identifiers: Rising float current-meters.

A comparison is made of rising float and current meter measurements for three rivers having discharges of 250 cusecs, 3,500 cusecs and 10,000 cusecs. The results suggest that an accuracy of a few percent should be readily attained with a properly engineered rising float system. Although less accurate, the technique of using the difference in performance for floats having different terminal velocities could be usefully employed in some circumstances. (Knapp-USGS)
W71-00597

INFORMATION PROCESSING IN WATER RESOURCES RESEARCH,
O'Brien and Gere, Syracuse, N.Y.
M. D. Lagrega, P. Moffa, J. McDonnel, and P. Sze.
Fifth International Water Pollution Research Conference, San Francisco, July 26-August 2, 1970. Preprint. 19 p, 7 fig, 1 tab, 9 ref.

Descriptors: *Analytical techniques, *Mathematical studies, *Water resources, *Computer models, Data processing Computer programs, New York, Eutrophication, Management, Monitoring, Sampling, Phosphates, Chemical cnalysis, Biota, Phytoplankton, Engineering, Zooplankton, Fish, Correlation analysis, Temperature, Regression analysis, Dissolved oxygen, Dissolved solids, Diatoms, Statistical methods, Coliforms, Alkalinity, Biochemical oxygen demand, Conductivity, Wind velocity.
Identifiers: Onondaga Lake (NY), Statistical analysis, Limnological investigations.

On the premise that all lakes are unique and require a distinct program of sampling and analysis for their evaluation, the objective of the preliminary investigation was to determine what measurement techniques should be employed. During the detailed phase, emphasis was placed on sampling those locations most representative of the major portion of Onondaga Lake, reflecting changes of a relatively long duration. The computer is essential for evaluating voluminous and complex data accumulated in the limnological investigations. Consideration was given to the form of input data, programming, and filing structure, and data presentation--the latter important in conveying representation of lake events. Plotted output was the most effective. Statistical analysis was useful in clarifying trends and establishing a base for further investigations. Specific programs, such as Mineral-Equilibria, were used to determine existing chemical relationships. The results of all techniques were used to arrive at the lake's trophic status upon which engineering considerations for pollution abatement were based. In response to growing public concern, Onondaga County (New York) adopted a comprehensive program to improve conditions in the watershed and restore the lake as a recreational center. (Jones-Wisconsin)
W71-00662

THE DETERMINATION OF THE BIOMASS AND THE NITROGEN CONTENT OF PLANKTON AND ITS PRACTICAL APPLICATION,
Marianne Pavoni.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 987-997, 1969. 5 fig, 1 tab, 14 ref.

Descriptors: *Biomass, *Plankton, *Nitrogen, *Methodology, Diatoms, Depth, Lakes, Stratification, Water pollution control, Sampling, Rotifers, Copepods, Daphnia, Cyanophyta, Bacteria, Detritus.
Identifiers: Particulate nitrogen, Dry weight.

Investigations of net sample fractions, cultures of Oscillatoria rubescens and Synedra acus, and samples of ulfiltered lakewater gave results in which ash-free dry weight, particulate nitrogen and biomass are in relatively good agreement. Relationship between organic weight, particulate nitrogen and biomass vary depending on algal species and specific plankton composition. Diatoms possess a smaller nitrogen content per organic dry substance. Diatom biomass estimated from cell volume is generally too high, as the cell vacuoles are also counted. From unfiltered lakewater the relationship of biomass to nitrogen within a sample series is generally constant, but may vary greatly from time to time. The following method in lake investigations of nitrogen, especially in routine survey programs for determination of the organic substance formed at the moment, is suggested: determination of particulate nitrogen at different depths and calculation of biomass of one or two mixed samples at least (proportionated according to water column height between sampling points) according to stratification of the lake, so that an average factor may be attained to assess plankton biomass. Thus a picture of lake biological conditions may be obtained to evaluate problems in water pollution control. (Jones-Wisconsin)
W71-00667

PHYSIOLOGICAL-ECOLOGICAL STUDIES OF BENTHIC ALGAE IN LABORATORY STREAMS,
Oregon State Univ., Corvallis. Dept. of Botany.
C. David McIntire.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 1, p 1940-1952, 1968. 3 fig, 2 tab, 18 ref.

Descriptors: *Physiological ecology, *Benthic flora, *Algae, *Hydraulic models, Laboratory tests, Periphyton, Streams, Photosynthesis, Respiration, Microorganisms, Light intensity, Carbon dioxide, Dissolved oxygen, Temperature, Velocity, Cyanophyta, Biomass, Insects, Diatoms, Chlorophyta, Chrysophyta, Grazing, Snails, Age, Turbidity, Diptera, Mayflies, Detritus.
Identifiers: *Respirometer chamber.

Physiological ecology of benthic algal communities were studied in laboratory streams. Relative abundance of algal species depended on seasonal fluctuations in chemical and physical properties of the creek water in the experimental streams and combinations of light intensity and current velocity. Periphyton accumulated on rubble and

gravel growing surfaces most rapidly at relatively high light intensities and current velocities, but was retarded at high densities of grazing snails. Export rate of community material depended on factors influencing biomass accumulation, community age, current velocity and silt load. With communities developed at a light intensity of 550-foot candle, increase in concentration of molecular carbon dioxide markedly increased photosynthetic rate at illumination intensities near and above 1000-foot candle. At light intensities below 500-ft c, a temperature increase of 10C had no significant effect on photosynthetic rate, but at intensities above 1000-ft c, the temperature coefficient varied between 1.3 and 1.6. Community respiration increased exponentially with temperature increases in air-saturated water. Respiratory rates decreased rapidly as dissolved oxygen was reduced below air-saturation. Experiments with laboratory communities suggested that, in certain ecological investigations, the benthic periphyton community may be viewed as a single functional unit or quasi-organism. (Jones-Wisconsin)
W71-00668

THE USE OF THE RADIOCARBON METHOD FOR SUBDIVISION OF PLANKTONIC ANIMALS ACCORDING TO THEIR TROPHIC LEVELS (IN RUSSIAN),
Akademiya Nauk SSSR. Institut Okeanologii; Akademii nauk SSR, Moscow. Institut Biologii Vnutrennjkh Vod.
E. A. Shushkina, and A. V. Monakov.
Doklady Academy of Sciences of USSR, Vol 184, No 4, p 955-958, 1969. 1 fig, 2 tab, 10 ref.

Descriptors: *Phytoplankton, *Zooplankton, *Laboratory tests, *Trophic level, Radioactivity techniques, Food chain, Daphnia, Chlorella, Scenedesmus.
Identifiers: Predatory species, Bosmina, Polyphemus, Cyclops, Heterocope, Pristicephalus, Eudiaptomus, Mochlonix, Phytophagous.

Two liter volume glass vessels were filled with pond water containing zooplankton and some fine phytoplankton. The vessels received definite amounts of Chlorella and radioactive bicarbonate, and were incubated in the laboratory under natural light and 17-18C for 63 hours. At 12-hour intervals crustacean radioactivity and biomass, different trophic levels were determined by a Geiger counter. The method permitted the subdivision of animals into three fairly well defined trophic levels, the phytophagous crustaceans occupying the first and the larvae of white beam, the third level. Replacement of bicarbonate by labeled culture of Scenedesmus yielded a more pronounced subdivision of animals into three trophic levels represented by phytophagous Pristicephalus shadini, predatory Eudiatomus ambliodon, and facultative predators of Mochlonix spp, respectively. (Wilde-Wisconsin)
W71-00671

ON THE STATISTICAL APPROACH TO ECOLOGICAL STUDIES OF MARINE BACTERIA (IN RUSSIAN),
Gidrometeorologicheskii Institut Odessa (USSR).
For primary bibliographic entry see Field 02L.
W71-00672

TRITIUM - A HYDROLOGIC TOOL,
Geological Survey, Washington, D.C. Water Resources Div.
Gordon L. Stewart.
Annals of Arid Zone, Vol 8, No 2, p 275-281, September 1969. 4 fig, 7 ref.

Descriptors: *Tracers, *Tritium, *Precipitation (Atmospheric), *Radioactivity, *Groundwater movement, Radioactivity techniques, Measurement, Hydrogeology, Clays, Deuterium, Hydrogen, Weather data, Groundwater recharge, Hydrologic data, Radioisotopes, Fallout.
Identifiers: *Tritium pulse.

In selecting a hydrologic tracer, many considerations are involved and cost is one of the most important. Tritium, an isotope of hydrogen, has the advantage of being incorporated into the water molecule, emits low energy beta radiation, has a half-life of 12.26 years and minimizes costs because it is detectable at extremely low concentrations. In general its effects on confining media are negligible although there is some evidence of a high adsorption loss in clay-water systems. Tritium is normally produced at low levels in the atmosphere by cosmic radiation, but since 1952, thermonuclear explosions have universally tagged precipitation with high levels. There is a seasonal peak during the late spring--early summer period and the resulting tritium pulse is extremely useful in hydrogeological work. Mean annual levels decrease yearly and vary with latitude. Modern tritium rainout is of greatest use in areas of rapid recharge where groundwater patterns may be studied. Measuring techniques and general applications are described. (Casey-Arizona)
W71-00690

USE OF SEISMIC REFRACTION MEASUREMENTS FOR GROUND WATER PROSPECTING,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 02F.
W71-00860

SOIL WATER MEASUREMENT BY A LOW-RESOLUTION NUCLEAR MAGNETIC RESONANCE TECHNIQUE,
Rothamsted Experimental Station, Harpenden (England).
R. E. Prebble, and J. A. Currie.
Journal of Soil Science, Vol 21, N0 2, p 273-288, September 1970. 16 p, 12 fig, 1 tab, 8 ref.

Descriptors: *Nuclear moisture, Meters, *Soil moisture meters, *Nuclear magnetic resonance, *Calibrations, Analytical techniques, Instrumentation, Soil moisture, Porosity, Clay minerals, Moisture content.
Identifiers: England.

Low-resolution nuclear magnetic resonance analysis was used to measure soil water. The physical principles of the method are outlined. Two sands, five soils, and vermiculite were tested in the laboratory. The instrument readings for all were depressed below the values that might have been expected from absolute water contents. In sands the depression increases with water content, that is, as pores of progressively larger size fill with water. In clay soils an initial depression is attributable to the rigidity with which the first small amounts of water are adsorbed on to the clay lattice: with more water the depression, as in sand, reflects the size distribution of the macropores. 'Relaxation,' a condition needed to ensure accuracy, can be induced by adding iron compounds and salts, but there is evidence that where these substances are present naturally in the soil they may cause different degrees of relaxation from soil to soil. When many soil samples of known type, structural state, and chemical status have to be analyzed, a good calibration curve can be obtained and used to give water contents to a fraction of a percent. (Knapp-USGS)
W71-00870

DIRECT READING FROST GAGE IS RELIABLE, INEXPENSIVE,
Forest Service (USDA), St. Paul, Minn. North Central Forest Experiment Station.
Alfred Ray Harris.
Research Note NC-89, Sept 15, 1970. 2 p.

Descriptors: *Frost, *Frozen soils, Wisconsin, Instrumentation.
Identifiers: Frost depth gage.

A tube-type gage is economical, easy to make, and is a reliable indicator of frost depth. Gage readings were within plus or minus 5 centimeters of indicated true frost depth 95 percent of the time. (Harris-Forest Service)
W71-00913

THE USE OF ENVIRONMENTAL SATELLITE DATA FOR MAPPING ANNUAL SNOW-EXTENT DECREASE IN THE WESTERN UNITED STATES,
Allied Research Associates, Inc., Concord, Mass.
For primary bibliographic entry see Field 02C.
W71-00946

TRITIUM IN SURFACE WATER HYDROLOGY-EXPERIMENTAL DETERMINATION OF THE RUNOFF COEFFICIENT (FRENCH),
Bureau of Geological and Mining Research, Orleans (France).
For primary bibliographic entry see Field 02A.
W71-01060

THE GRAVIMETRIC METHOD OF SOIL MOISTURE DETERMINATION, PART I - A STUDY OF EQUIPMENT, AND METHODOLOGICAL PROBLEMS,
South Pacific Regional Coll. of Tropical Agriculture, Alafua (Western Samoa).
For primary bibliographic entry see Field 02G.
W71-01064

THE GRAVIMETRIC METHOD OF SOIL MOISTURE DETERMINATION, PART II - TYPICAL REQUIRED SAMPLE SIZES AND METHODS OF REDUCING VARIABILITY,
South Pacific Regional Coll. of Tropical Agriculture, Alafua (Western Samoa).
For primary bibliographic entry see Field 02G.
W71-01065

THE GRAVIMETRIC METHOD OF SOIL MOISTURE DETERMINATION, PART III - AN EXAMINATION OF FACTORS INFLUENCING SOIL MOISTURE VARIABILITY,
South Pacific Regional College of Tropical Agriculture, Alafua (Western Samoa).
For primary bibliographic entry see Field 02G.
W71-01066

SOME OF ESSA'S CURRENT EFFORTS IN SATELLITE DATA APPLICATIONS FOR HYDROLOGY,
National Environmental Satellite Center, Washington, D.C.
Donald R. Baker, and E. Paul McClain.
In: The Progress of Hydrology, Vol 1 - New Developments in Hydrology, Proceedings 1st International Seminar for Hydrology Professors, Illinois University, Urbana, July 13-25, 1969, p 108-125, published by Univ of Illinois, 1969. 18 p, 6 fig, 21 ref.

Descriptors: International Hydrological Decade, Conferences, *Research and development, *Satellites (Artificial), *Synoptic analysis, Aerial photography, Surveys, Water resources development, Forecasting, Hydrology, Hydraulics, Data collections, Hydrologic data, Snowpacks, Sea ice, Soil moisture, Planning, Projects, Research facilities, Exploration, Economics, Permafrost, Laboratories, Technology, Computers, Instrumentation.
Identifiers: *Water resources research.

There exists an economic and scientific requirement for comprehensive and timely measurement and analysis of hydrologic factors, especially over watersheds where hydrologic survey data are too scant for adequate conservation, management, and prediction of the water resources of the area. Some of the required information can be acquired by remote sensors aboard aircraft or satellites; other data may or only, be obtained from in situ instrumentation, which often can use satellite relay of the data to a forecast or analysis center. Representative

of the more readily obtainable hydrologic information from current satellites (such as ESSA, ATS, and Nimbus) is areal extent of ice and snow cover. ESSA and NASA are examining sensors for obtaining important hydrologic data including the water equivalent of snow, the depth of frozen ground, and the moisture profile in the soil. One promising area of search is in the microwave (active and passive) portion of the electromagnetic spectrum. (See also W71-01067) (Knapp-USGS)
W71-01068

SPACE TECHNOLOGY IN HYDROLOGIC APPLICATIONS,
Geological Survey, Washington, D.C.
Charles J. Robinove.
In: The Progress of Hydrology, Vol 1 - New Developments in Hydrology, Proceedings 1st International Seminar for Hydrology Professors, Illinois University, Urbana, July 13-25, 1969, p 88-107, published by Univ of Illinois, 1969. 20 p, 2 tab, 4 ref.

Descriptors: International Hydrological Decade, Conferences, *Research and development, *Remote sensing, *Satellites (Artificial), Water resources development, Forecasting, Hydrology, Hydraulics, Synoptic analysis, Infrared radiation, Aerial photography, Radar, Surveys, Planning, Projects, Research facilities, Exploration, Economics, Laboratories, Technology, Computers, Instrumentation.
Identifiers: *Water resources research.

The recent advent of remote-sensing devices provides a capability to collect data economically and repetitively. Space sensing involves the use of passive and active transmitters and receivers of electromagnetic radiation in satellites to collect data on earth features and phenomena. The most familiar sensing device is the photographic camera. Narrow angle lenses (less than 20 deg) provide orthographic terrain pictures when used from orbital altitudes. Such pictures contain little or no distortion due to relief displacement and allow deeper penetration of water than wide angle systems. Infrared-color photography is useful for interpretation of vegetated areas. Multispectral photography is being investigated for its usefulness in hydrology. Infrared sensor data are interpretable in terms of the temperature of water surfaces and the approximate moisture content of the soil and rocks near the surface. Side-looking airborne radar is an excellent tool for all-weather, day or night, coverage of large areas. (See also W71-01067) (Knapp-USGS)
W71-01069

REMOTE SENSING IN SPACE TECHNOLOGY IN HYDROLOGY,
Connecticut Univ., Storrs. Dept. of Civil Engineering.
Paul Bock.
In: The Progress of Hydrology, Vol 1 - New Developments in Hydrology, Proceedings 1st International Seminar for Hydrology Professors, Illinois University, Urbana, July 13-25, 1969, p 61-87, published by Univ of Illinois, 1969. 27 p, 22 ref.

Descriptors: International Hydrological Decade, Conferences, *Research and development, *Remote sensing, *Satellites (Artificial), Forecasting, Hydrology, Hydraulics, Surveys, Planning, Projects, Research facilities, Water resources development, Exploration, Economics, Instrumentation, Laboratories, Technology, Computers.
Identifiers: *Water resources research.

Remote sensing with space technology applied to earth observations including hydrology is rapidly developing. An earth observation satellite ERTS-A is being planned and built. Television and multispectral point scanner imagery will be produced in large quantities for studies by hydrologists and other earth scientists. Hydrologists must solve new problems using new approaches. These include the interpretation of the imagery; their areal, repetitive, global nature; their multi-disciplinary implications including national and international questions. Universities must undertake both basic and applied research within a centralized, mission-oriented remote sensing and space technology program. (See also W71-01067) (Knapp-USGS)
W71-01070

RECENT DEVELOPMENTS IN MEASURING TECHNIQUES FOR FLOW IN OPEN CHANNELS,
Geological Survey, Washington, D.C. Water Resources Div.
George F. Smoot, and Harry H. Barnes, Jr.
In: The Progress of Hydrology, Vol 1 - New Developments in Hydrology, Proceedings 1st International Seminar for Hydrology Professors, Illinois University, Urbana, July 13-25, 1969, p 194-225, published by Univ of Illinois, 1969. 32 p, 12 fig, 3 tab, 6 ref.

Descriptors: International Hydrological Decade, Conferences, *Reviews, *Stream gages, *Discharge measurement, Open channel flow, Measurement, Stage-discharge relations, Water resources development, Forecasting, Hydrology, Hydraulics, Water measurement, Current meters, Flowmeters, Tracers, Projects, Research facilities, Instrumentation, Tracking techniques, Gaging stations, Laboratories, Technology.
Identifiers: *Water resources research, Stream gaging.

Conventional techniques for measuring the discharge of streams by current meter are standardized and well known. Some sites, however, are not particularly suited to the traditional means of measurement. This paper presents three recent developments resulting from the continuing search by the U. S. Geological Survey for improved methods and new techniques for measuring under such unusual conditions as the extremely unsteady flows in large estuaries, flows at which no stable stage-discharge relationships exist, flows in shallow and turbulent mountain streams, or flows under ice cover. Each of the techniques is discussed with regard to its applicability to these unusual flow conditions. (See also W71-01067) (Knapp-USGS)
W71-01085

PRINCIPLES OF THE APPLICATION OF NUCLEAR TECHNIQUES TO HYDROLOGIC INVESTIGATIONS,
Geological Survey, Denver, Colo.
L. L. Thatcher.
In: The progress of Hydrology, Vol 1 - New Developments in Hydrology, Proceedings 1st International Seminar for Hydrology Professors, Illinois University, Urbana, July 13-25, 1969, p 149-193, published by Univ of Illinois, 1969. 45 p, 9 fig, 41 ref.

Descriptors: International Hydrological Decade, Conferences, *Reviews, *Radioactivity techniques, *Tracking techniques, Research and development, Nuclear meters, Stable isotopes, Radioisotopes, Tracers, Water resources development, Forecasting, Hydrology, Hydraulics, Nuclear moisture meters, Soil moisture meters, Projects, Research facilities, Exploration, Instrumentation, Geophysics, Laboratories, Technology.
Identifiers: *Water resources research.

Applications of nuclear techniques have developed in many areas of hydrology but are most important in groundwater. The major applications in the hydrology of groundwater, the unsaturated zone, surface water and water pollution are selectively reviewed with emphasis on applications of more general interest. Groundwater applications are of two types: first, applications that provide information on the regional characterisitics of aquifers, such as average transmissibility over long distances, average residence time and recharge sources; and, second, applications which give local information on individual wells and the aquifer immediately surrounding them. Regional information is provided by investigative techniques based on the 'environmental isotopes.' These are isotopes that are present in the atmosphere and are circulated through the hydrologic cycle in essentially the same way as the water molecule. Local information is provided by the nuclear logging methods and tracer methods based on the artificial injection of tracer. (See also W71-01067) (Knapp-USGS)
W71-01086

NUCLEAR TECHNIQUES IN HYDROLOGY,
International Atomic Energy Agency, Vienna (Austria). Section of Hydrology.
Bryan R. Payne, and Turgut Dincer.
In: The Progress of Hydrology, Vol 1 - New Developments in Hydrology, Proceedings 1st International Seminar for Hydrology Professors, Illinois University, Urbana, July 13-25, 1969, p 126-148, published by Univ of Illinois, 1969. 23 p, 29 ref.

Descriptors: International Hydrological Decade, Conferences, *Nuclear meters, *Radioactivity techniques, Stable isotopes, Radioisotopes, Water resources development, Hydrology, Hydraulics, Nuclear moisture meters, Soil moisture meters, Tracers, Tracking techniques, Planning, Projects, Research facilities, Exploration, Instrumentation, Geophysics, Borehole geophysics, Laboratories, Technology, Research and development.
Identifiers: *Water resources research.

The application of nuclear techniques in hydrology provides a powerful tool to the hydrologist, not only to solve routine problems, but also new problems for which no solution was known before. The fact that water, even in its vapor state in the atmosphere, can be identified by its isotopic composition and is continuously being labelled on a world-wide scale during the hydrologic cycle, gives to the hydrologist the possibility of solving problems which would have been impossible. At present most environmental isotope laboratories are at universities. This favors hydrologic research dealing with environmental isotopes, provided that the laboratory staff and faculties of engineering and geology have a close cooperation. The establishment of environmental or artificial isotope laboratories in organizations responsible for water resources development should be encouraged and courses on the application of nuclear techniques in hydrology at different levels should be organized to inform the practicing hydrologists of the recent developments in these applications. (See also W71-01067) (Knapp-USGS)
W71-01087

7C. Evaluation, Processing and Publication

WATER RESOURCES INVESTIGATIONS IN THE SUSQUEHANNA RIVER BASIN,
Geological Survey, Harrisburg, Pa.
For primary bibliographic entry see Field 02E.
W71-00564

WATER RESOURCES INVESTIGATIONS IN THE UPPER OHIO RIVER BASIN,
Geological Survey, Harrisburg, Pa.
For primary bibliographic entry see Field 02E.
W71-00566

QUANTITATIVE MAPPING OF SALINITY, VOLUME, AND YIELD OF SALINE AQUIFERS USING BOREHOLE GEOPHYSICAL LOGS,
Geological Survey, St. Louis, Mo.; and Geological Survey, Austin, Tex.
A. N. Turcan, Jr., and A. G. Winslow.
Water Resources Research, Vol 6, No 5, p 1478-1481, October 1970. 4 p, 2 fig, 4 ref.

Descriptors: *Borehole geophysics, *Saline water, *Transmissivity, *Water yield, Aquifers, Saline water systems, Water resources development, Electrical studies, Resistivity, Porosity, Permeability, Subsurface investigations, Logging (Recording),

Salinity, Surveys, Investigations, Data collections, Hydrologic data, Hydrogeology, Louisiana.
Identifiers: Saline water resources (La).

Techniques that permit a quick, practical, and satisfactory evaluation of electrical logs were developed to estimate the volume and distribution of saline water in aquifers in Louisiana. Of about 200,000 available electrical and induction-electrical logs, approximately 1000 representative logs (about 1 per township) were selected for detailed analysis. An empirical relation, called the field formation resistivity factor was determined as the ratio of formation resistivity to water resistivity corrected to a temperature of 25 deg C. The field formation resistivity factor was used to estimate the altitude of groundwater salinity zones of 1,000, 3,000, and 10,000 milligrams per liter of dissolved solids. Average coefficients of permeability and bed thickness data were used to determine coefficients of transmissibility. Using theoretical and standard conditions of well design, yield, and aquifer thickness, well yields were computed. This permitted an areal comparison of yield from each of the saline water zones. (Knapp-USGS)
W71-00571

ACQUISITION AND MACHINE PROCESSING OF SALINE WATER DATA FROM SOUTHEASTERN NEW MEXICO AND WESTERN TEXAS,
Geological Survey, Albuquerque, N. Mex.
W. L. Hiss.
Water Resources Research, Vol 6, No 5, p 1471-1477, October 1970. 7 p, 7 fig, 10 ref.

Descriptors: *Data collections, *Data processing, *Data storage and retrieval, *Hydrologic data, *Brines, Water quality, Groundwater, Oil industry, Oil fields, Oil wells, Oil reservoirs, Digital computers, Computer programs, Statistics, Saline water.
Identifiers: Permian Basin oil fields (N Mex), Saline water resources.

Approximately 20,000 saline water analyses obtained chiefly from oil companies and related service companies operating in the Delaware basin of southeastern New Mexico and western Texas were indexed to the Permian Basin Well Data System (PBWDS) magnetic tape file, coded, punched into tabulating cards, and stored on magnetic tape for computer operations. Location and operator indexes prepared from the PBWDS file were absolutely essential to efficient machine data processing operations. Extensive manual and computer error checks for duplication and accuracy were made to eliminate data errors resulting from the following: poorly located or identified samples; nonrepresentative or contaminated samples; mistakes in coding, reproducing, or keypunching; laboratory errors; and inconsistent reporting. The original 20,000 analyses considered were reduced to approximately 9000 representative analyses. Costs of acquisition and establishment of the data file approximated $5.00 per usable record. The compiled data were used in a study of the saline water resources of the Permian Artesia group and Capitan and San Andres limestones in southeastern New Mexico and western Texas. (Knapp-USGS)
W71-00572

SYNTHETIC GENERATION OF SEASONAL PRECIPITATION,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 02B.
W71-00600

GROUNDWATER ATLAS OF NEBRASKA (REPRINTED JUNE 1969).
Nebraska Univ., Lincoln. Conservation and Survey Div.

Nebraska University Conservation and Survey Division Atlas, 1969. 7 p, 7 plate, 1 map.

Descriptors: *Groundwater, *Water resources, *Maps, Topography, Observation wells, Irrigation wells, Water quality, Water levels.
Identifiers: *Hydrogolic Atlas, Test holes, Groundwater in storage.

Maps that are pertinent to the groundwater conditions throughout Nebraska are included in the report as follows: Plate 1, Base map of Nebraska; Plate 2, Topographic regions; Plate 3, Groundwater survey test holes, observation wells, and distribution of irrigation wells; Plate 4, Groundwater in storage, Plate 5, Groundwater quality; Plate 6, Contours of water table and depth to static water level; Plate 7, Groundwater regions. (Woodard-USGS)
W71-00613

COMPILATION OF DATA FOR MICHIGAN LAKES,
Geological Survey, Lansing, Mich.
For primary bibliographic entry see Field 02H.
W71-00637

CLIMATIC ATLAS OF NORTH AMERICA MEAN SEA AND LAKE SURFACE TEMPERATURES,
Weather Wing (4th), Ent AFB, Colo.
Clarence E. Everson, and Donald T. Brissett.
Available from NTIS as AD-709 887, $3.00 in paper copy, $0.95 in microfiche. June 1970. 46 p. Technical Paper 70-3.
Identifiers: *Meteorological charts, North America, *Atlantic Ocean, Surface temperatures, *Pacific Ocean, Surface temperatures, *Great Lakes, Surface temperatures, Temperature, Sea ice, Climatology.

Monthly charts of mean sea surface temperatures of the Atlantic Ocean from North America to 30 degrees W, Pacific Ocean from North America to 170 degrees E, and the mean lake surface temperature for the Great Lakes are presented.
W71-00784

ON THE COMPUTER EVALUATION OF THIESSEN WEIGHTS,
Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center.
For primary bibliographic entry see Field 02A.
W71-00864

THE pH OF WATER IN FLORIDA STREAMS AND CANALS,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 02K.
W71-00883

LOW-FLOW FREQUENCIES OF ILLINOIS STREAMS,
Geological Survey, Washington, DC.
For primary bibliographic entry see Field 02E.
W71-00884

WATER RESOURCES OF THE CENTRAL NEW YORK REGION,
Geological Survey, Albany, N.Y.
For primary bibliographic entry see Field 02E.
W71-00894

CONSUMPTIVE USE OF IRRIGATION WATER IN WYOMING,
Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 03F.
W71-00901

AN APPROACH TO THE SELECTION OF A STREAMFLOW BASE PERIOD,
Wyoming Univ., Laramie. Dept. of Civil Engineering.
William Norris Embree.

M.S. Thesis, Wyoming University Graduate School, June 1970. 99 p, 26 fig, 13 tab, 24 ref, 4 append. OWRR Project A-001-WYO (33).

Descriptors: *Streamflow, *Statistics, *Correlation analysis, Synthetic hydrology, Computers, Equations.
Identifiers: Historic data, Base period, Residual mass curves.

Wyoming streamflow records were examined to determine if base periods exist. A base period is a shorter period of record which exhibits the same statistical characteristics as the longer record and can therefore be used in simplifying the study of water resource projects. It was determined that, for twenty-three representative streamflow gaging stations selected, the twenty-year period 1948-1968 provides sufficient information for use as a base period. Maps, tables, and curves pertinent to the study are included. (Woodard-USGS)
W71-00905

U.S. GEOLOGICAL SURVEY FLOOD-MAPPING PROGRAMS,
Geological Survey, Fairfax, Va.
F. Paul Kapinos.
Virginia Polytechnic Institute and State University Water Resources Research Center Bulletin 39, p 75-86, July 1970. 12 p.

Descriptors: *Mapping, *Flood plains, *Surveys, Flood control, Data collections, Floods, Flood protection, Flood plain zoning, Hydrologic data, Surface waters, Frequency analysis, Historic flood, High water mark, Profiles, Hydrographs.
Identifiers: Flood plain mapping.

The principal objective in flood-mapping programs is to provide information that can be used to help reduce and control flood losses. These programs will provide technical information needed for sound economic development of flood plain lands, aid in the improvement of flood-forecasting systems and improve our basic knowledge of floods and flood hazards. The U.S. Geological Survey engages in flood-mapping programs throughout the United States and Puerto Rico. Most programs have been designed to provide data on flood frequency and to prepare Hydrologic Atlases that depict areas inundated by historical floods. Recently, however, particularly in the Federal Programs, the trend has been to prepare flood maps indicating areas inundated by floods of various frequencies. Flood-plain maps of the Hydrologic Atlas Series of the U.S.G.S. describing both historical floods and floods of various recurrence intervals have been prepared in 22 states and Puerto Rico. (Knapp-USGS)
W71-01056

SPECIAL FLOOD HAZARD INFORMATION REPORT ON SOUTH LEE COUNTY COASTAL AREAS.
Corps of Engineers, Jacksonville, Fla.
For primary bibliographic entry see Field 06F.
W71-01057

DETERMINISTIC NONLINEAR HYDROLOGIC MODELS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02A.
W71-01081

STATISTICAL SUMMARIES OF MICHIGAN STREAMFLOW DATA,
Geological Survey, Lansing, Mich.
For primary bibliographic entry see Field 02E.
W71-01088

THE ISOLATION OF RANDOM ERRORS IN PERIODIC RAINFALL,
Calgary Univ., Alberta. Dept. of Geography.
Lawrence C. Nkemdirim.
Water Resources Bulletin, Vol 6, No 5, p 767-774, September-October 1970. 8 p, 1 fig, 1 tab, 10 ref.

Descriptors: *Statistical methods, *Rain gages, *Homogeneity, *Variability, Stochastic processes, Rainfall disposition, Sampling, Data collections, Estimating, Hydrologic data, Probability.
Identifiers: Error estimation.

The problem of isolating random errors from rainfall measurements in watersheds of relatively small size is discussed. The residual variance is a practical measure for assessing the error term. (Knapp-USGS)
W71-01100

08. ENGINEERING WORKS

8A. Structures

SPILLWAY DESIGN FLOODS FOR SMALL DAMS IN RURAL MISSOURI,
Missouri Water Resources Research Center, Columbia.
T. E. Harbaugh, and J. E. Thompson.
Available from NTIS as PB-195 284, $3.00 in paper copy, $0.95 in microfiche. Completion Report Missouri Water Resources Research Center, June 1970. 22 p, 2 tab, 12 fig, 4 ref. OWRR - A-025-MO (1).

Descriptors: *Design flood, *Small dams, *Spillways, Statistical methods, Water resources development, Floods, Dam safety, Hydrology, Multiple regression, Missouri.

At present 1970, over 1500 small dams exist within the boundaries of the State of Missouri. Estimates indicate the number is growing at the rate of one hundred to two hundred per year. The main factor in possible failure of these existing dams is an inadequate spillway resulting from poor hydraulic practice and or lack of accurate hydrologic design information. This report presents the result of a state wide analysis of all existing hydrologic data for rural watersheds less than twenty square miles. The results are presented in nomograph form for the 25 and 50 year frequency floods. The report also contains equations for other frequencies at two accuracy levels. The results of this investigation should provide designers of spillways, culverts and bridges with the latest hydrologic flood frequency data for small rural Missouri watersheds.
W71-00626

EARTHQUAKE DESIGN OF COOLING TOWERS,
University of Western Ontario, London. Dept. of Engineering Sciences.
Salman H. Abu-Sitta, and Alan G. Davenport.
Journal of the Structural Division, ASCE, Vol 96, No ST9, Proc Paper 7524, Sept 1970, p 1889-1902. 8 fig, 21 ref.

Descriptors: *Cooling towers, *Dynamics, *Earthquakes, Structural engineering, Vibrations.
Identifiers: *Hyperbolic parabolic shells, Natural frequency, Engineering mechanics, Equivalence factor.

A dynamic statistical approach is used to predict dynamic stresses in a hyperboloidal cooling tower due to earthquake. It is shown that the configuration associated with one circumferential wave is the only one which is excitable by earthquake force and that the first mode of such configuration is dominant. On the basis of this, an equivalent static load is calculated. In the present treatment, boundaries at the base are assumed fixed. This reduced bending moments to negligible proportions. The existence of bending moments and the contribution of modes higher than the first can be easily incorporated in the dynamic treatment. The importance of earthquake design is evident from the comparative values of stresses produced by various loads. For instance in the example given, dead loads produce meridional stress at the fixed base in the order of 270 psi, static wind loads 550 psi, and dynamic earthquake 1140 psi. The data presented give coefficients for equivalent static loads, natural frequencies of cooling towers, and static stresses for seismic load. The information given in the paper provides a simplified analysis to predict dynamic earthquake stresses in cooling towers. (Upadhyaya-Vanderbilt)
W71-00656

STORM DRAINAGE FACILITIES, UNION COUNTY, NEW JERSEY.
Union County Planning Board, N.J.
For primary bibliographic entry see Field 03D.
W71-00827

ROTARY VIBRATORY FINE SCREENING OF COMBINED SEWER OVERFLOWS,
Cornell, Howland, Hayes and Merryfield, Corvallis, Oreg.
For primary bibliographic entry see Field 05G.
W71-00872

SEWER MONITORING AND REMOTE CONTROL-DETROIT.
Detroit Metro Water Services, Mich.
For primary bibliographic entry see Field 05G.
W71-00876

MINING WATER IN IRAN,
Utah State Univ., Logan. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 04B.
W71-00958

STABILITY OF HYPERBOLOIDAL COOLING TOWER,
Uillinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics; and Marley Co., Kansas City, Mo.
Henry L. Langhaar, Arthur P. Boresi, Robert E. Miller, and Jerry J. Bruegging.
Journal of Engineering Mechanics Division, ASCE, Vol 96, No EM5, Proc Paper 7635, p 753-779, Oct 1970. 2 fig, 2 tab, 11 ref.

Descriptors: *Cooling towers, Mathematical model, Winds, Stability.
Identifiers: Fort Martin tower, Buckling, Finite elements, Hyperbolic shells, Linear algebra, Orthotropism, Partition method, Piecewise polynomials.

Theory of instability of an elastic orthotropic shell of revolution subjected to uniform external normal pressure is developed. The theory leads to a linear eigenvalue problem for determination of the buckling pressure. Illustrative numerical calculations based on piecewise-polynomial approximations and the partition method are given for the Fort Martin tower erected in West Virginia. The tower is a reinforced concrete hyperboloidal shell of revolution 370 ft. high and 5.5 in. thick for most of its height. A study of cylindrical shells under wind loading indicates that the present theory is conservative if it is used to estimate dynamic pressure, (1/2) PV2, at which the shell will buckle. Possibly the explanation is that the primary cause of buckling of a cooling tower is the internal vacuum created by wind blowing over the top. Over much of the external surface, the pressure is below that of the atmosphere, and this condition tends to cancel the internal vacuum. (Upadhyaya-Vanderbilt)
W71-00984

8B. Hydraulics

STABILITY OF A SAND BED SUBJECTED TO A SHEAR FLOW OF LOW FROUDE NUMBER,
Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 02J.
W71-00560

MODEL TEST RESULTS OF CIRCULAR, SQUARE, AND RECTANGULAR FORMS OF DROP-INLET ENTRANCE TO CLOSED-CONDUIT SPILLWAYS,
Illinois State Water Survey, Urbana.
Harold W. Humphreys, Gunnar Sigurdsson, and H. James Owen.
Illinois Water Survey Report of Investigation 65, 1970. 70 p, 72 fig, 11 tab, 11 ref.

Descriptors: *Spillways, *Drops (Structures), *Vortices, Outlet works, Pipes, Pipe flow, Closed conduit flow, Hydraulics, Spillway crests, Discharge (Water), Flow control, Overflow, Stage-discharge relations.
Identifiers: Closed-circuit spillways.

Hydraulic model studies were performed to develop closed-conduit spillways with single-valued characteristics and to develop criteria for predicting their minimum hydraulic performance when vortex formation at the inlet is not controlled. The model tests included circular, square, and rectangular forms. Although the occurrence of the vortex is unpredictable, a method is presented that can be used to determine when a drop-inlet spillway requires an antivortex device for satisfactory hydraulic performance. Also, a method is presented for determining the minimum performance of a drop-inlet spillway when the vortex-formation is uncontrolled. A horizontal circular plate positioned above the drop-inlet crest of a circular drop-inlet spillway is shown to be an effective antivortex device. Also, a properly positioned plate can significantly reduce the head necessary for the spillway to prime and flow full of water when compared with the priming head at the intersection of the usual weir- and full-flow curves. The plate in this position will also influence the head on the drop inlet and the spillway performance in the normal weir-flow range. For a properly positioned plate large increases in spillway discharge can be obtained for very small increases in the reservoir level. The influence of the antivortex plate on the spillway performance and capacity can be determined from the experimental equation presented. The spillway flow conditions associated with the plate are described. (Knapp-USGS)
W71-00636

METHOD FOR DISCHARGE MEASUREMENTS IN IRRIGATION OUTLETS,
Technion - Israel Inst. of Tech., Haifa. Dept. of Civil Engineering.
For primary bibliographic entry see Field 03F.
W71-00694

FLOW OF DILUTE POLYMER SOLUTIONS IN ROUGH PIPES,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Michael Poreh.
April 1970, 25 p. IIHR Report no. 126. NR Task 062-217.
Identifiers: *Polymers, Additives, *Skin friction, Reduction, *Pipes, Surface roughness, Solutions, Mathematical models, Pipe flow, *Drag reducing fluids.

A simplified model is developed to describe the effects of boundary roughness on drag reduction achieved by polymer additives. The model is suitable for both uniform and nonuniform roughness. Predictions of friction coefficients by means of the model are in reasonable agreement with experimental results.
W71-00793

DRAG REDUCTION BY EJECTING ADDITIVE SOLUTIONS INTO A PURE-WATER BOUNDARY LAYER,
Hydronautics, Inc., Laurel, Md.
Jin Wu, and Marshall P. Tulin.
Available from NTIS as AD 709 083, $3.00 in paper copy, $0.95 in microfiche. June 1970. 32 p. Technical Report no. 353-7. Contract Nonr-4181 (00).

Identifiers: *Drag, Reduction, *Boundary layer, Additives, Ejection, Polymers, Viscoelasticity, Water, Flat plate models, *Drag reducing fluids.

Drag reduction caused by ejecting additive solutions from a slot into a pure-water boundary layer on a flat plate was systematically studied. Results include drag measurements for a plane boundary, smooth and rough, with various openings of the slot and with various concentrations and discharges of the ejected additive solution. Conclusions were drawn on the additive requirement in external flows and on the ejection technique for an optimum drag reduction.
W71-00800

DU PONT PLANTS EFFLUENT DISPERSION IN DELAWARE RIVER: HYDRAULIC MODEL INVESTIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 05G.
W71-00813

CHANNEL IMPROVEMENT, FIRE ISLAND INLET, NEW YORK. HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
William H. Bobb, and Robert A. Boland.
Available from NTIS as AD-709 588, $3.00 in paper copy, $0.95 in microfiche. November 1969. 35 p, plates, figs. Technical Report H-69-16.
Identifiers: *Inland waterways, Hydraulic models, *Beaches, Erosion, Dams, Tides, Stabilization, Ocean currents, Construction, Deflection, Breakwaters, Sand, Atlantic Ocean, New York, *Fire Island Inlet (New York), *Channel stabilization, Littoral drift, Dikes, Beach erosion, Shore protection.

Fire Island Inlet, located on the south shore of Long Island, N.Y., connects the Atlantic Ocean with Great South Bay. The inlet is about 3 miles long and approximately 1/2 mile wide, extending generally east and west between Oak Beach on the north and the western end of Fire Island on the south. Great South Bay, to which Fire Island Inlet is the main entrance, is a tidal body 25 miles long and 2 to 5 miles wide with a general depth of about 6 to 25 ft at mlw. Attempts have been made to stabilize an entrance channel through Fire Island Inlet with little success. To study this problem a fixed-bed model (later converted to a movable-bed model was constructed to scale ratios of 1:500 horizontally and 1:100 vertically, reproducing all of Fire Island Inlet and a portion of the Atlantic Ocean. Tides, tidal currents, and wave action in the Atlantic Ocean were reproduced. Results indicated that the plan originally recommended by the New York District, which included a littoral drift trap located in the entrance to the inlet, a rehandling basin in the inlet, a connecting channel of adequate depth for navigation by a loaded hopper dredge, and a 500-ft extension to the Federal Jetty. The construction of groins, deflection dikes, and closure dikes would not appreciably improve conditions obtained by the recommended plan alone. A plan involving an offshore breakwater and a littoral drift trap located between the breakwater and the beach would also function satisfactorily in every respect.
W71-00822

JET DIFFUSION IN STAGNANT STRATIFIED WATERS,
Royal Inst. of Tech., Stockholm (Sweden).
For primary bibliographic entry see Field 05B.
W71-00835

FLUID MODEL STUDIES OF THE STORAGE OF FRESHWATER IN SALINE AQUIFERS,
Louisiana State Univ., Baton Rouge.
For primary bibliographic entry see Field 04B.
W71-00838

RUNOFF ROUTING THROUGH STEEP NATURAL CHANNELS,
Research Council of Alberta, Edmonton.
Rolf Kellerhals.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY11, Paper 7666, p 2201-2217, November 1970. 17 p, 6 fig, 2 tab, 19 ref, 2 append.

Descriptors: *Routing, *Open channel flow, *Surges, *Unsteady flow, Turbulent flow, Tracers, Bores, Model studies, Hydraulic models, Runoff, Dispersion, Channel morphology, Hydraulics.
Identifiers: Steep channels.

Equations describing steady and unsteady tumbling flow in steep, natural channels are developed and their parameters are evaluated on the basis of field experiments. The hydrologically significant aspects of steady flow can be expressed as a relation between mean storage per unit length and discharge. These functions are evaluated experimentally for 13 test reaches using tracer methods. An exponential form provides consistently good fit to the data. The parameters can be computed from readily available basin data. Nondimensional analysis supports this experimental fact. Unsteady flow data are obtained by observing the passage of small, artificially created surges through the test reaches. Wave propagation appears to be essentially kinematic, but with strong dispersive effects caused by storage in the pool-like channel segments between the frequent critical flow sections. A partial differential equation describing unsteady flow in this type of channel is derived and solved for the initial and boundary conditions of the surge tests. A note on longitudinal dispersion is added. (Knapp-USGS)
W71-00842

GEOMETRIC AND FRICTIONAL EFFECTS OF SUDDEN RELEASES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Shis-Tun Su, and Albert H. Barnes.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY11, Paper 7650, p 2185-2200, November 1970. 16 p, 8 fig, 1 tab, 9 ref, 2 append.
NSF Grant GK-1892.

Descriptors: *Waves (Water), *Bores, *Floods, *Unsteady flow, *Surges, Non-uniform flow, Turbulent flow, Open channel flow, Channel morphology, Water level fluctuations, Reservoir operation.
Identifiers: Reservoir releases.

The effects of resistance and channel cross-sectional geometry on waves caused by sudden water release are investigated. The analytical treatment follows Dressler's approach with the modification that channel cross-sectional geometry is included. Results obtained by the analysis include water surface profiles, mean velocity distribution, and trajectory of wave fronts for different Chezy coefficients in rectangular, parabolic and triangular cross-sections. (Knapp-USGS)
W71-00843

AN EQUATION FOR VORTEX MOTION INCLUDING EFFECTS OF BUOYANCY AND SOURCES WITH APPLICATIONS TO TORNADOES,
National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center.
For primary bibliographic entry see Field 02B.
W71-00845

REPRODUCIBILITY IN HYDRAULIC MODELS OF PROTOTYPE RIVER MORPHOLOGY,
J. A. Zwamborn.
La Houille Blanche (Grenoble), Vol 21, No 3, p 291-298, 1966. 8 p.

Descriptors: *Channel morphology, *Model studies, *Hydraulic similitude, *River beds, Engineering structures, Roughness (Hydraulic), Scour, Hydraulic models, Prototype tests.
Identifiers: South Africa, Engineering problems.

To solve river engineering problems in South Africa a technique of movable-bed hydraulic models was used. The studies included siting a new bridge, mapping extent of general riverbed scour, determination of local bridge pier scour and river control works. Similarity criteria are given for building the models: Froude's law, conformity of sediment motion, and friction criterion. Geometric distortion of the various models varied from 3.3 to 1.5. Both sand and crushed anthracite were used for bed material. Before completion of the studies a severe flood occurred in one of the river basins and was successfully reproduced in the model; riverbed changes and local scour effects were correctly reproduced to scale. It is concluded that, by using the above similarity criteria, the behavior of models can be expected to yield satisfactory qualitative and quantitative results. (Lang-USGS)
W71-00898

SCALE MODELS SOLVE WATER FLOW PROBLEMS,
F. C. Olds.
Power Engineering, Vol 74, p 40-43, January 1970. 8 fig.

Descriptors: *Hydraulic models, *Hydraulic similitude, *Heat transfer, Thermal stratification, Water temperature, Thermal conductivity, *Model studies.
Identifiers: Heat flow models.

The role of hydraulic models for thermal discharge design is discussed. In the current work load at Alden Research Laboratories, Worcester Polytechnic Institute, there are 20 river and estuary studies for a variety of purposes including thermal discharge. The technique used in this laboratory for thermal discharge modeling is described from the standpoint of efficiency, approximation of prototypes and replacing by other types of models such as computer models. The computer models can fully replace physical muscles. The use of photography techniques for thermal discharge modelings is described. Many of Alden's thermal models cover 20,000 sq. ft. or more. It has been decided that water affected by plant discharges should remain in the model boundaries through two or three tidal cycles. (Novotny-Vanderbilt)
W71-00968

TRANSIENT FLOW BETWEEN PARALLEL DRAINS,
California Univ., Los Angeles; and San Jose State Coll., Calif.
For primary bibliographic entry see Field 04A.
W71-01063

8C. Hydraulic Machinery

UNITED STATES V APPALACHIAN ELECTRIC POWER CO (FEDERAL GOVERNMENT'S REGULATORY AUTHORITY OVER HYDROELECTRIC PLANT ON A NON-NAVIGABLE, INTERSTATE RIVER).
For primary bibliographic entry see Field 06E.
W71-01052

8D. Soil Mechanics

EXPERIMENTAL SAND DRAIN STUDY, NAPA RIVER PROJECT, MARE ISLAND,
California State Div. of Highways. Materials and Research Dept.
Travis Smith, W. G. Weber, Jr., Early Shirley, D. R. Howe, and George H. C. Chang.
Available from NTIS as PB-191 357, $3.00 in paper copy, $0.95 in microfiche. Final Report October 1969, 111 p. Research Report 632324.
Identifiers: *Bridges, Soil mechanics, *Sand, Drainage, Hydrology, Soils, Underwater, Compressive properties, Levees, Hydrostatic pressure, Permeability, Statistical data, California.

The results of a special study, involving the use of sand drains to aid the consolidation of weak compressible soils, are presented. Settlements, excess hydrostatic pressures, strength and moisture changes, instrumentation, movements, and failures are discussed. It was found that actual consolidation time lagged behind the theoretical predictions in the sand drain areas. This lag could be predicted by theoretical consideration of the disturbance caused by the displacement method of sand drain installation. High excess hydrostatic pressures, caused by the sand drain installation contributed to failure of the embankment in the sand drain area.
W71-00807

8E. Rock Mechanics and Geology

CRACKING OF EARTH AND ROCKFILL DAMS. A THEORETICAL INVESTIGATION BY MEANS OF THE FINITE ELEMENT METHOD,
Harvard Univ., Cambridge, Mass.
Sergio W. Covarrubias.
Available from NTIS as AD-708 935, $3.00 in paper copy, $0.95 in microfiche. Final report, April 1969. 166 p. Contract Report S-69-5. Contract DACW39-69-C-0029.
Identifiers: *Dams, Foundations, Structures, *Foundations, Cracks, Shear stresses, Rock, Geology, Soil mechanics, Construction materials, Particle size, Elasticity, Revetments, Crack propagation, Mathematical models, Computer programs, Finite element analysis, Computer analysis, *Earth dams, Rockfill dams.

The principal purpose of this study was to investigate by means of the finite element method the effect of the shape of abutments, the effect of compressibility of the foundation, and the effect of zoning of dams on the development of tension cracks in earth and rockfill dams. All materials were assumed to be linearly elastic, with equal properties in tension and in compression. The only load considered was the weight of the embankment, and it was assumed to be applied in a single lift. These assumptions exaggerate the development of tension zones and, therefore, are considered to be justified for the purposes of this investigation. Comparison of the results of finite element analyses of four dams which have cracked, or in which large tension zones have developed, with the observed performance of these dams, has demonstrated good agreement between the theoretical results and the observations. Detailed investigation by means of the finite element method included sixteen longitudinal and fourteen transverse cross sections of idealized dams and the above-mentioned four case records. These analyses showed that by application of the finite element method it is indeed possible to locate zones within dams where tension cracks are likely to develop. The agreement between the observed and computed tension zones and the distribution of longitudinal strains along the crest was found to be reasonably good.
W71-00801

8G. Materials

CONTROLLING DEPOSITS IN COOLING-WATER SYSTEMS,
Nalco Chemical Co., Chicago, Ill.
E. S. Troscinski, and R. G. Watson.
Chem Eng, Vol 77, No 5, p 125-132, Mar 1970. 8 p, 8 fig, 3 tab, 14 ref.

Descriptors: *Cooling water, *Cooling towers, *Scale, Fouling, Costs, *Corrosion, *Calcium compounds, *Magnesium compounds, Iron oxides, Water treatment, Velocity, Heat transfer, Concentration, Dissolved solids, *Heat exchangers, Microorganisms.
Identifiers: *Cooling systems, Scale-forming compounds, Corrosion inhibitors, *Scale prevention, High temperature.

Various deposit-control programs for recirculating water-cooling systems show how such programs prevent premature breakdown of equipment through corrosion and fouling. Initially, deposits form mainly in high-temperature areas such as heat-transfer surfaces and in sections of a system where the velocity of the cooling water is 1 ft/sec or less. Later, there is a tendency for the solids to disperse and redeposit elsewhere in the system. Except for rare instances, such deposits consist of combinations of a wide variety of scales and foulants, rather than of one single type. Mechanisms and types of deposits are discussed. (USBR)
W71-00642

8I. Fisheries Engineering

VETERINARY SUPERVISION FOR FISHERY WATERS,
Bureau of Commercial Fisheries, Washington, D.C. Office of Foreign Fisheries.
N. Franshtein.
Available from NTIS as PB-192 871T, $3.00 in paper copy, $0.95 in microfiche. Trans. from Veterinariya, Vol. 34. Free translation, February 1970, 2p.
Identifiers: *Fishes, *Diseases, Veterinary medicine, Rivers, Lakes, USSR, *Fisheries.

The organization and carrying out of veterinary measures in fishery waters have been entrusted to the chiefs of the regional stations, in regard to animal disease control; and the accomplishment of necessary diagnostic and hydrochemical investigations - to the directors of the regional veterinary laboratories. All fishery waters (rivers, lakes, reservoirs, ponds) have been assigned to veterinary districts, stations for animal disease control. The veterinary service of the USSR in recent years, carried out veterinary-sanitary rating of pond farms, studied their epizootic condition and accomplished a number of measures for the liquidation of fish diseases.
W71-00823

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

MATHEMATICAL METHODOLOGY IN HYDROLOGY,
Arizona Univ., Tucson. Hydrology and Water Resources.
For primary bibliographic entry see Field 06A.
W71-00722

THE PROGRESS OF HYDROLOGY.
For primary bibliographic entry see Field 06A.
W71-00733

10. SCIENTIFIC AND TECHNICAL INFORMATION

THE ROLE OF MIXING IN STRATIFIED FLOWS - AN ANNOTATED BIBLIOGRAPHY,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 02E.
W71-00650

A SYSTEM OF INFORMATION CENTERS FOR RESEARCH AND DECISION MAKING,
Urban Inst., Washington, D.C.
Charles C. Holt.
American Economic Review Vol LX, No 2, p 149-165, May 1970.

Descriptors: *Decision making, *Data collection, Government, Research and development, *Cost, *Computers, Programs, Economic efficiency, Planning, Forecasting, Economies of scale.
Identifiers: *Economic research, *Privacy, Communications, Public administration, Information centers, Library services.

The paper explores the area of data and computer utilization in the context of research and public policy decision making. The author is interested in seeing where data and computer utilization relate to policy decisions. Thus, the interconnections are traced between basic research, problem-oriented research, program planning, decision making and government operations. A number of problems are pointed out including: the inadequacy of applied and programmatic research, communication break-downs between the research and decision levels and low quality programming. The author recommends that new institutions and programs in applied and programmatic research should be developed, along with a national system of flexible, decentralized, but intercommunicating information centers. The analysis stresses the strong interrelatedness of research, decisions, data, computing, library services and different disciplines, institutions and problems. Effective policy decision making in the water resource area requires full utilization of existing economic data. This article, therefore, is relevant to efforts aimed at improving the efficiency of the decision making procedures which exist in the water resource planning process. (Murphy-Rutgers)
W71-00747

OCEANOGRAPHY: A BIBLIOGRAPHY OF SELECTED ACTIVATION ANALYSIS LITERATURE.
National Bureau of Standards, Washington, D.C., Analytical Chemistry Div.

Available from the NTIS as PB 192 877, $3.00 in paper copy, $0.95 in microfiche. June 1970, various paging. NBS Technical Note 534.
Identifiers: *Oceanology, *Radioactivation analysis, *Bibliographies, Radioactivation analysis, Sea water, Fishes, Shellfish, Algae, Seaweed, Trace elements, *Neutron activation analysis.

The literature of oceanography in activation analysis is reindexed in detail with respect to Element Determined, Matrix Analyzed and Technique Used for precise literature searching. An author index is included. Candidates for inclusion in this bibliography were extracted from Matrix Analyzed categories of fish, shellfish, seaweed marine sediments and seawater.
W71-00795

POLLUTION ANALYSIS: A BIBLIOGRAPHY OF THE LITERATURE OF ACTIVATION ANALYSIS.
National Bureau of Standards, Washington, D.C. Analytical Chemistry Div.

Available from the NTIS as PB 192 876, $3.00 in paper copy, $0.95 in microfiche. June 1970, various pagings. NBS Technical note 532.
Identifiers: *Air pollution, *Radioactivation analysis, *Water pollution, Radioactivation analysis, *Bibliographies, Radioactivation analysis, Food, Pesticides, Dust, Drugs, Soils, Trace elements, *Neutron activation analysis.

The literature of the use of activation analysis of pollution samples is reindexed in detail with respect to Element Determined, Matrix Analyzed and Technique Used for precise literature searching. An author index is included. Candidates for inclusions in this bibliography were extracted from the matrix, categories water, air atmosphere, foodstuffs, pesticides, particles, dusts, drugs and soils.
W71-00796

PUBLICATIONS OF WATER RESOURCES INVESTIGATIONS IN COLORADO, AND

SELECTED PUBLICATIONS PERTAINING TO COLORADO.
Geological Survey, Denver, Colo. Water Resources Div.

Geological Survey Open-file Report, April 1970. 22 p.

Descriptors: *Bibliographies, *Publications, *Colorado, *Water resources, *Hydrogeology, Data collections, Hydrologic data, Groundwater, Surface waters, Water supply.
Identifiers: Water resources bibliography (Colo).

Water resources and hydrogeologic publications pertaining to Colorado up to 1970 are listed in a bibliography which also discusses where the publications may be obtained or consulted. Their prices are also listed if applicable. (Knapp-USGS)
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C. Others		
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Environmental Science Services Administration	W71-00945--00946	2

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CENTERS OF COMPETENCE AND THEIR SUBJECT COVERAGE

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the EPA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

Supported by the Environmental Protection Agency in cooperation with WRSIC.

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.
- Agricultural Livestock Wastes at the Department of Agricultural Engineering of Iowa State University.

Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

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